

Control Strategy Preparation
Manual for Photochemical Oxidant

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The Clean Air Act, as amended, provided that for each national ambient air quality standard (NAAQS) promulgated by the EPA, a State Implementation Plan (SIP) was to be developed which was to contain emission control measures that would provide for attainment and maintenance of such national standards, generally within three years of the approval of the SIP. This Control Strategy Preparation Manual for Photochemical Oxidant has been prepared to provide guidance to State and local control agencies on the development of an approvable control plan. The procedures outlined in this document should be followed by States, or EPA where necessary, in developing an approvable control strategy for photochemical oxidant. Section I provides an overview of the various factors to be considered in the development of an approvable control strategy for photochemical oxidant. Section II sets forth a fairly concise step-by-step procedure that a control strategy developer should follow in preparing an approvable control strategy. Section III provides, in question-and-answer format, ...

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CONTROL STRATEGY PREPARATION MANUAL
FOR
PHOTOCHEMICAL OXIDANT



U.S. ENVIRONMENTAL PROTECTION AGENCY

Office of Air Quality Planning and Standards

Research Triangle Park, North Carolina

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INTRODUCTION

The Clean Air Act, as amended, provided that for each national ambient air quality standard (NAAQS) promulgated by the EPA, a State Implementation Plan (SIP) was to be developed which was to contain emission control measures that would provide for attainment and maintenance of such national standards, generally within three years of the approval of the SIP. Experience has shown that not all SIP's developed by the States in early 1972 were adequate to provide for attainment and maintenance of the photochemical oxidant standard by July, 1975. Further, it is now known that violations of the photochemical oxidant standard are more pervasive than were originally thought a few years ago.

Consequently a major activity of EPA within Fiscal Year 1976 was the review of each SIP to determine its adequacy to provide for attainment and maintenance of national standards. When a SIP was determined to be substantially inadequate, the State was advised by EPA that a SIP revision was needed. States are required to submit a revised SIP, where necessary, by July 1978. At that time, all needed achievable control regulations for stationary sources shall be submitted. In cases where additional controls are needed, generally land use and transportation measures, they shall be submitted by July, 1978. The revised SIP will be required to contain adequate measures to provide for attainment and maintenance.

This Control Strategy Preparation Manual for Photochemical Oxidant has been prepared to provide guidance to State and local control agencies

on the development of an approvable control plan. The procedures outlined in this document should be followed by States, or EPA where necessary, in developing an approvable control strategy for photochemical oxidant.

There are three notable issues which are not covered by this manual. These are:

- (1) Substitute for the Appendix J relationship.
- (2) The use of photochemical reactivity in SIP development, and
- (3) The definition of the area that should be considered for control.

OAQPS is currently investigating these three issues. A task force has been developed on substitutes for Appendix J and considerable review both within and out of the agency has proceeded with the expected date of culmination approximately April 1977. A public meeting was held on the use of photochemical reactivity in October 1976 and a policy is being developed on the basis of information gained there and through other reviews. The expected date of reissuance of policy on this subject is April 1977. The definition of the area over which controls should be applied has been difficult to determine because of the many variables involved. Review of the policy is currently underway with completion expected in approximately April 1977. As these issues are resolved, the policy papers will be distributed through direct mailing to Regional Office personnel for distribution to State and local agencies as appropriate. Additionally, the appropriate pages of this guideline will be modified as explained on page iv. Also, the entire guideline will be included in the OAQPS Guideline Series; thus making the information available to State and local agencies from the Regional Office libraries.

While these three issues are important to the development of a control strategy much work can proceed without a full definition of the policy on these three issues. This manual discusses most of the other aspects of photochemical oxidant problems and their relationship to control strategy development. The work that can proceed includes updating emission inventories, projection of growth and its resulting emissions, and allocating resources to develop control strategies.

The reader will note that throughout this document the term "organic compound" is used in lieu of the more common term "hydrocarbon." The term "hydrocarbons" was initially used by EPA to include all organic compounds. Some confusion has resulted from use of this term with regard to which carbon containing compounds should be considered for control. To further explain, the term "hydrocarbons" specifically refers to those compounds containing only carbon and hydrogen while organic compounds refer to all compounds containing carbon except for carbon monoxide and carbon dioxide and a few other compounds. Therefore the term "organic compounds" has been used in this document to more explicitly define the compounds to be considered for control.

FORMAT

The Control Strategy Preparation Manual for Photochemical Oxidant is separated into four sections. Section I provides an overview of the various factors to be considered in the development of an approvable control strategy for photochemical oxidant. Section II sets forth a fairly concise step-by-step procedure that a control strategy developer should follow in preparing an approvable control strategy. Section III provides, in question-and-answer format, additional information to provide a more detailed explanation of the recommended procedures outlined in Section II. Section IV includes additional information on existing inspection/maintenance programs.

This manual will be revised from time to time to take account of new information. To facilitate the revision procedure the manual has been punched so as to allow insertion into a looseleaf binder. Additionally the pages are numbered according to section and are dated. When revisions to this document are received they may easily be inserted in the appropriate place simply discarding the old pages.

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I

OVERVIEW OF FACTORS AFFECTING ATTAINMENT OF NATIONAL PHOTOCHEMICAL OXIDANT STANDARDS

The following statements summarize the pertinent facts concerning the nature and extent of the photochemical oxidant problem and the technical information available to assist in the analysis and development of approvable photochemical oxidant control strategies.

1. The National Ambient Air Quality Standard (NAAQS) for photochemical oxidant (Ox) is 160 ug/m^3 (0.08 ppm) one-hour average not to be exceeded more than once per year.

2. Photochemical oxidant is not a specific compound but a broad group of diverse compounds with ozone (O_3) - being by far the most abundant single component - selected as the indicator for pollution control purposes. Photochemical oxidant is not emitted directly but is formed in the atmosphere with its primary precursors being non-methane organic compounds (NMOC) and oxides of nitrogen.

3. Violations of the ambient photochemical oxidant standard are more pervasive than originally believed. In addition to high concentrations observed in many urban areas, studies in the Midwest and East have found high levels of oxidant in rural areas.

4. Preliminary analysis of special study data indicates that high oxidant levels in rural areas can generally be attributed to long range transport of oxidant and its precursors from urban areas. Further,

this condition also occurs in conjunction with specific weather patterns. While the Agency suspects high rural oxidant levels result from transport of man-made emissions from urbanized areas, further study is needed and is being conducted.

5. There is at times a significant natural background which on some occasions may exceed levels of more than half the national standard. However it is believed that the contribution of natural sources is generally small in urban areas in relation to peak oxidant concentrations.

6. The current Federal Reference Method (FRM) calibration method for photochemical oxidant is difficult to use and a 5 to 10% positive bias exists even when great care is taken in the procedure. The Agency is in the process of testing new calibration procedures. As an interim measure, field operators have been provided with improved instructions for using the current calibration method which will minimize the error. In addition, another study showed that the FRM monitoring system, even when used by experts, probably underestimates the true ambient oxidant concentrations. The magnitude of the negative bias is generally larger than the positive bias associated with the calibration method.

7. NO_x is known to both destroy and produce Ox. Smog chamber and mathematical modeling studies indicate that the effect of NO_x upon oxidant formation interacts with the organic compound effect resulting in extremely complex oxidant-organic- NO_x relationships. Notwithstanding such complexities, it has been established that the relative levels of NMOC and NO_x in ambient air are such that the most effective approach

to oxidant reduction is based upon maximum NMOC control. In some cases it may be beneficial to control NO_x sources to minimize O_3 , however at the present time, because of limited information, it is too premature to require such controls. Additional investigation is continuing.

8. Organic compounds are emitted from both stationary and mobile sources. On a national basis, approximately 50% are from stationary sources (e.g., chemical manufacturing, evaporation, solid waste disposal, etc.) and 50% from mobile sources (e.g., autos, trucks, aircraft, etc.). Of course, this distribution of emission sources will vary within any given area, with many urban areas having more mobile source emissions than stationary source emissions.

9. Emissions of organic compounds from light-duty vehicles, light-duty trucks and heavy-duty vehicles are regulated by statute on time schedules independent of that for attainment of national standards. The 94th Congress considered modifications to current automotive emission rates. It is anticipated that some Congressional action on this subject will be taken in the near future. Thus, precise estimates of growth in automotive emissions into the 1980's are difficult to make at the present time.

10. Reevaluations of smog chamber studies indicate that given enough time nearly all non-methane organic compounds will react in the photochemical oxidant process. Previously, it was believed that only certain, more "reactive" organics participated in the process. This new insight will require a change in the historical regulatory

philosophy of control of organic compounds to one of minimizing all NMOC, rather than only those organics previously thought to be "reactive."

11. At the present time, few control regulations are available to implement a "total" non-methane organic control strategy. Regulatory approaches are needed and are under development at the present time.

In recognition of these factors, and in accordance with the need to attain and maintain the national photochemical oxidant standard, the following points should be considered in developing an approvable control strategy for photochemical oxidant where needed:

(A) Where an existing State Implementation Plan (SIP) is substantially inadequate to provide for attainment and maintenance of the national photochemical oxidant standard, the plan must be revised.

(B) In recognition of transport from urban areas (Statement 4), the control of photochemical oxidant should primarily center upon sources within an urban area. Actions instituted in urban areas will produce benefits in outlying areas and in the more distant downwind areas as well. However, the Agency encourages State initiated organic emission reduction actions over broad geographical areas such as those considered at the Multi-State Conference at Moodus, Connecticut in September, 1975.

(C) In recognition of our limited knowledge on the impact of control of NO_x on photochemical oxidant at the present time, a control strategy to minimize ambient photochemical oxidant concentrations in urban areas should include reductions in man-made non-methane organic emissions and should not necessarily include NO_x emission control regulations.

(D) In order to determine the degree of control possible by sources, it may be necessary to obtain specific emission information concerning the type and amounts of non-methane organic compounds emitted from the source. Applicable control techniques may vary from source to source, depending upon the chemical and physical properties of the organics emitted. Hence, such information, in addition to the "total" non-methane organic compounds emitted may be needed.

(E) The degree of non-methane organic compound control needed to provide for attainment of the photochemical oxidant standard should be estimated using Appendix J (or an acceptable substitute). Though there are acknowledged deficiencies with Appendix J, it is, at this time, the recommended source/receptor relationship for photochemical oxidant. The Agency is evaluating and validating a wide range of photochemical oxidant models and in early 1977 will publish alternative(s) to Appendix J. The new techniques will attempt to accommodate transport and the effect of NO_x .

(F) Where needed to provide for attainment and maintenance of the O_x standards, all achievable control measures for non-methane organic compound sources shall be required. Those measures which are achievable for stationary sources and transportation and land use related sources are identified in paragraphs (I) and (K) below.

(G) The determination of control measures for stationary sources is under rather extensive review at the present time. The existing example organic compound control regulations published in Part 51, Appendix B,* are no longer considered as describing available technology for such sources.

(H) In recognition of the fact that all organics will react in the photochemical process, control of all non-methane organic compounds rather than just the more reactive organic compounds will be needed to provide for attainment of national standards in many areas. Unfortunately, in the near term, a substantial reduction of all non-methane organic emissions from stationary sources is not generally achievable. Because of the different physical and chemical properties of the organic compounds emitted from processes, it is usually unworkable to draft control regulations which encompass a wide variety of emission source categories. In the future, it will usually be necessary to establish control regulations applicable to individual source categories.

(I) Definitions of available control technologies for certain stationary sources are presently under investigation. Activities specific to the control of organics for coating operations for existing plants are proceeding within the following source categories: the paper industry, the fabric industry (coating and rubberizing), the can and coil industries, and the assembly of auto and light truck industry. A final document containing information on available control

*Appendix B to CFR, Part 51, may soon be revoked.

technologies for these sources will be distributed to the Regional Offices as an OAQPS Guideline shortly. In addition, similar work has begun on the following source categories: the film and foil coating industries, the dry cleaning industry and those operations using organic compounds for degreasing. Information such as the degree of achievable control, the costs involved, the time required to install or modify a process is being considered and documented.

(J) In those areas where the reactivity definition included in the Los Angeles Rule 66 has been adopted, States should be encouraged to continue to require source compliance with its provisions.

(K) Available control measures for transportation and land use related sources include: (1) Inspection/Maintenance, (2) Vapor Controls for Gasoline Marketing, (3) Heavy Duty Vehicle (HDV) Retrofit,^(1,2) (4) Transit Improvements, (5) Employer Incentives, (6) Parking Management/Restrictions, (7) Traffic Management/Restrictions, and (8) Ship and Barge Controls. Two measures are considered not reasonably available. They are gasoline rationing and retrofit for light-duty vehicles.

¹Review of Control Strategies for In-Use Vehicles, EPA 460/3-74-021, Dec., 1974.

²Evaluation of Retrofit Devices for Heavy Duty Vehicles - NYC Dept. of Air Resources, Bureau of Motor Vehicle Pollution Control, EPA Grant # S-802909, Dec., 1975.

(L) Attainment of the national photochemical oxidant standard in certain areas of the nation with very high population densities, and/or which are affected by summer air stagnation conditions will be difficult. However, control agencies must reduce oxidant levels to the lowest practicable level, as quickly as possible. If needed, all achievable controls must be adopted to provide for improvement in air quality toward the eventual attainment and maintenance. However, the Agency does not intend to require States to adopt unachievable or unreasonable regulations (e.g., gas rationing). Amendments to the Clean Air Act to support such a position were considered by the 94th Congress.

(M) The Boston CO/Ox SIP (40 CFR Part 52, June 12, 1975, FR 25152) should serve as a prototype for revised oxidant SIP's where achievable controls are inadequate to provide for attainment and maintenance. Where all achievable control regulations submitted by the States are inadequate to attain standards, the submittal should be considered an interim plan, with other control measures being explored and adopted as they become available. Although the plan would not contain a demonstration that the standard will be attained, there should be a demonstration of the effect of the promulgated regulations in relation to the final degree of control needed. The plan shall also identify those additional actions that will be taken in the future.

(N) Because all achievable regulations will probably be needed in many areas of the nation to attain and maintain the national standard for photochemical oxidant, the adoption of achievable control

measures should be relatively uniform nationwide; however, the sequence and time of implementation of these measures may be somewhat different in different areas for good cause and will require judgment by the State and EPA Regional Office.

(0) The Agency program for oxidant reduction is complex and broad and is not limited to SIP's. Development of new source performance standards (NSPS) and the Federal Motor Vehicle Control Program (FMVCP) are key features in controlling growth of organic emissions. To date, New Source Performance Standards for organic compounds require the installation of a floating roof on petroleum storage tanks.⁽¹⁾ Recently, an internal EPA Task Force has been organized in an attempt to accelerate the pace of development of NSPS for organic chemical manufacturing sources.

The following is a list of sources for which it is anticipated that new source performance standards will be developed or revised and the expected year of proposal.

<u>Year</u>	<u>Source Categories</u>
1977	Petroleum storage and transfer of crude oil and gasoline
1977	Gasoline marketing regulations (terminals)
1977	Dry cleaning
1977	Coating of automobiles and light trucks on assembly lines
1977	Solvent degreasing
1978	Stationary internal combustion engines

⁽¹⁾ 39 FR 9317, March 8, 1974.

1978	Storage and transfer of organic liquids other than gasoline and crude oil
1978	Petroleum refineries
1978	Waste solvent disposal
1978	Car coating
1978	Paper coating
1978	Coil coating
1978	Fabric coating

II

SUMMARY OF PROCEDURES REQUIRED FOR THE REVIEW AND/OR DEVELOPMENT OF A STATE IMPLEMENTATION PLAN CONTROL STRATEGY FOR PHOTOCHEMICAL OXIDANTS

Scope and Objectives

The development of an air pollution control strategy designed to attain and maintain the National Ambient Air Quality Standards (NAAQS) requires an analysis of current and possible future air quality problems. It is the objective of this section to briefly present the quantitative and qualitative procedures used in developing an acceptable plan for the control of photochemical oxidant. The amount of work involved in each step will vary from area to area depending on available data, magnitude of the oxidant problem, types of emissions sources, etc. These steps can be summarized as follows:

- STEP 1: Review available Ox air quality data to determine if sufficient data is available to determine the adequacy of the SIP.
- STEP 2: Determine the validity of available air quality data.
- STEP 3: Determine the second highest ambient 1-hour concentration.
- STEP 4: Analyze the adequacy of the SIP to attain/maintain national standards.
- STEP 5: Determine the geographic area to be considered in the analysis.
- STEP 6: Determine the sources of organic compound emissions in the area.
- STEP 7: Determine the degree of control needed to attain the NAAQS.
- STEP 8: Determine expected growth in emissions.

- STEP 9: Determine emission reduction required to attain/maintain the national standards.
- STEP 10: Determine whether existing emissions will be reduced by compliance with existing regulations.
- STEP 11: Where additional control measures are necessary, consider application of available control measures.
- STEP 12: Determine most expeditious date of attainment.

STEP 1: Review available Ox air quality data to determine if sufficient data are available to provide evidence that the national standards are not being attained or will not be maintained. Are sufficient data available to make such a judgment? Valid data^(1,2) from at least one oxidant "season" (i.e., April to October) should be available, however, 3 or more years data are preferable. Data should also be available from areas of expected maximum concentrations (i.e., 10 - 30 miles downwind of concentrations of emission sources), however lack of such data should not preclude the development of a control strategy if available data, though limited indicate valid violations of national standards.

STEP 2: If data exist to indicate a potential attainment or maintenance problem, review the ambient air quality data to determine its validity and representativeness.

(a) Review the location of the Ox monitors.⁽³⁾ Are they properly located in accordance with siting criteria? Are sites biased toward local interferences such that they do not represent areawide problems? Local source interference could be considerable for photochemical oxidant. Monitors should not be located too close to major roadways or point sources of NO_x, since such sources may have a scavenging effect on Ox, thereby indicating lower maximum concentrations than existing in the general area.

(1) Guidelines for the Evaluation of Air Quality Data, OAQPS 1.2-015, Feb., 1974.

(2) Guidelines for the Interpretation of Air Quality Standards, OAQPS 1.2-008, August 1974.

(3) Guidance for Air Quality Monitoring Network Design and Instrument Siting, OAQPS 1.2-012 (Revised), Sept., 1975.

(b) Determine if a satisfactory measurement procedure was used to collect Ox data being reviewed. The following measurement procedures are acceptable: Coulometric (SAROAD Method Code 13 and 15); Neutral KI Colorimetric (SAROAD Method Code 14); and Chemiluminescence (SAROAD Method Code 11). Data collected by other methods are unacceptable and data from such measurement techniques should not be used for control strategy purposes. (See page III-D-1.)

(c) Analyze the available Ox air quality data to assure its validity and reliability.

(1) Determine if the data were collected by monitors that are properly operated, maintained, calibrated, and that adequate quality control procedures were utilized to assure validity of data. (1) If it is believed that the data would not survive the scrutiny of a source challenge, then such data should be rejected. (2)

(1) Guidelines for the Evaluation of Air Quality Data. OAQPS 1.2-015, Feb. 1974.
Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. 1 - Principles - EPA-600/9-76-005, January 1976.

(2) It is recognized that the calibration method may result in a positive 10% bias. Further, it is recognized that a technical study indicates that a generally larger negative bias has been observed among experts following established calibration and monitoring procedures. On the surface, these studies tend to discredit all oxidant measurements, however upon examination, the 10% bias is relatively small in areas greatly in excess of the standard. Further, the generally larger negative bias among experts indicates that the actual ambient levels are worse (not better) than actually measured such that additional controls are probably needed beyond that indicated with measured data. Hence, oxidant measurements probably underestimate the true concentrations. Data properly collected under established procedures are good qualitative indicators of the minimum degree of control that is needed to attain national standards.

(2) Review specific data for determination of abnormal values. Obtain frequency distributions of O_x data. Inspection of the higher percentile values may identify abnormally high values. Also a review of when the maximum concentrations were measured may suggest abnormal or suspect data (e.g., nighttime vs. daytime). Where necessary, this review should include:

- (a) Strip charts and laboratory reports.
- (b) Field log books for notations concerning operations and maintenance activities.
- (c) Basic data to assure temporal balance of air quality data (e.g., a missing quarter of air quality data).
- (d) Changes made in sampling methodology, maintenance procedures, calibration procedures or quality control practices.
- (e) Meteorological conditions at time of maximum concentration.

(3) If abnormally high values have been measured and are considered suspect, it may be useful to review operating parameters for other instruments at the same monitoring site to determine whether electrical problems or heating/air conditioning problems may have caused abnormal values.

(4) Where available, review data from nearby monitoring sites and compare the concentrations measured by the other instruments at those sites with the high concentrations measured by sampling instruments at the site in question.

(5) If data are acceptable from a sampling point of view, to the degree possible explore unusual or non-reoccurring external problems that may have caused high oxidant concentrations.

(d) To determine if O_x air quality concentrations are representative, review the O_x air quality trend at each site for the area being studied.

(1) Review the O_x trend at each site to identify fluctuations in O_x levels.

(2) Review parameters that would help explain trend. Review organic and NO_x emissions inventory, and compliance information to determine if any significant changes (increases or decreases) in regional emission of organic compounds and/or NO_x have taken place.

NOTE: The purpose of Step 2 is to insure that the data which will be used as the basis of a control strategy and costly regulations are valid, or can reasonably be assumed to be valid. If it is believed that the data are questionable and factors exist that could reasonably challenge the data validity, then such data should not be used as the basis of a control strategy. If on the other hand, all reasonable measures have been followed in the collection of the data, and unless the validation efforts prove the data to be invalid, then such data should be assumed valid and useable.

STEP 3: Determine the second highest measured ambient 1-hour concentration that best represents ambient air quality levels in the area. For most areas, it will be equal to the second highest 1-hour average that occurred in a calendar year over the last 2 or 3 years. Measured data in lieu of statistically derived concentrations should be used as the basis of the control strategy (see pages III-B-3 and III-B-4).

STEP 4: If the second highest 1-hour ambient air quality concentration is equal to or above the national standard, it will be necessary to analyze the adequacy of the existing Ox control strategy to determine its ability to provide for attainment and maintenance of the NAAQS for photochemical oxidant.

STEP 5: Determine the geographic area to be considered in the analysis. From available data, determine the geographic area where emission sources need to be controlled. Evidence exists which indicates that oxidant and its precursors can be transported 100 miles or more. It is believed that a substantial portion of high oxidant measurements in non-urban areas result from transport of oxidant and its precursors from urban areas. Therefore, the control strategy should primarily concentrate on sources within the urban area. Control in such areas should reduce ambient concentrations in the urban and the surrounding area and more distant downwind areas.

STEP 6: Determine the sources of organic compound emissions in the area. This includes both mobile and stationary sources. Data are needed for two purposes: (a) to generally assess where the ambient oxidant problem originates; and (b) to determine the emissions reduction impact of various possible control regulations on source emissions.

Available emission data have been shown to be generally adequate to provide for the assessment of the organic compound emissions in an area, however, these data may not in all cases be adequate for possible control strategy evaluation. Since the control strategy is designed to minimize high oxidant concentrations in the "summer" months, emission estimates on a daily basis (seasonally adjusted) rather than annual data are desirable. Further, for control strategy design purposes, it may be necessary to have the following information:

(1) Specific organic compounds emitted - This information may be necessary when determining the applicability of control regulations.

(2) Emission variability - Due to the nature of many organic emissions (evaporative loss), organic usage and emissions may vary by season, whereas the process may not. Also some sources of organic may have a greater operating rate during the April to October period and therefore have a greater impact on ozone/oxidant levels than a source of the same size which operates at a constant level all year.

(3) Process equipment - In some cases of solvent usage, the operating conditions of the process can be adjusted to reduce emissions. A requirement for sources to operate equipment at a lower temperature or to place lids on vats of solvents may reduce the solvent usage and thereby decrease organic compound emissions.

Mobile sources also account for a large percentage of the organic compounds emitted to the atmosphere and must be inventoried. The inventory should include emission estimates for:

- (a) Light Duty Vehicles (LDV)
- (b) Light Duty Trucks (LDT)
- (c) Heavy Duty Gas Vehicles (HDGV)
- (d) Heavy Duty Diesel Vehicles (HDDV)
- (e) Motorcycles
- (f) Aircraft and others.

In order to calculate emissions for vehicles, the following information is needed:

- (a) The age distribution of vehicles and average VMT by age in the area. In lieu of this, the national age distribution (contained within AP-42*) can be used.
- (b) VMT by vehicle category.
- (c) Expected growth rate in VMT by vehicle category.
- (d) Average speed, temperature and the frequency of cold starts to hot starts in operating motor vehicles. (National averages are contained within AP-42.)

*Compilation of Air Pollution Emission Factors, and various supplements, EPA AP-42.

Emission estimates will need to be adjusted to reflect emission reductions that have occurred from source compliance with adopted regulations (see also step 10).

STEP 7: Using a source/receptor relationship, determine the degree of control needed to attain and maintain the NAAQS. In the near future, EPA will make available alternative models to Appendix J which may be used to determine the degree of control required. In those cases where a determination of the degree of control necessary is required Appendix J should be used. For oxidant concentrations above 0.28 ppm, a proportional relationship can be used to extend the Appendix J curve. This may be accomplished by the following procedure:

- (a) determine second highest concentration - assume 0.42 ppm for this example,
- (b) $\frac{0.42 - 0.28}{0.28} = 50\%$ reduction needed to attain 0.28 ppm,
- (c) 0.28 ppm requires 92% reduction to reach 0.08 ppm, and
- (d) $50\% + 92\% (100\% - 50\%) = 96\%$ control required at 0.42 ppm.

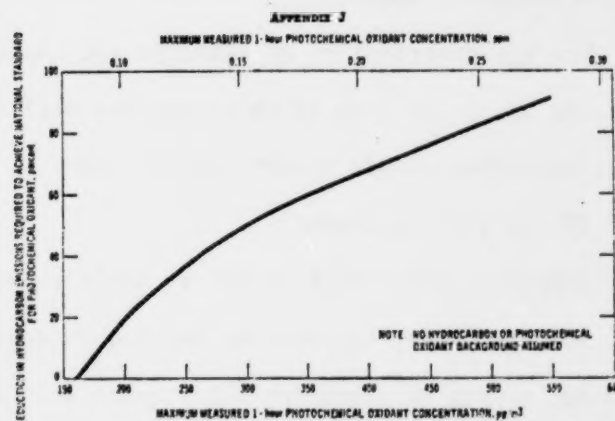


Figure 1. Required hydrocarbon emission control as a function of photochemical oxidant concentration. (Reference: Air Quality Criteria for Nitrogen Oxides, AP-34, Environmental Protection Agency, Washington, D.C., January 1971.)

Procedure

Using the second highest 1-hour ozone/oxidant concentration determined in Step (3), determine the percent reduction (R) in organic emissions necessary to attain the standard from Appendix J or an appropriate alternative model. Multiply the total base year emissions (E_T) determined in Step (6) by the necessary percent reduction required. This will yield the emission reduction (E_R) to existing sources required to provide for attainment.

$$(R) (E_T) = E_R$$

Example

If organic emissions in the base year were 50,000 tons and the 2nd highest 1-hour oxidant concentration was 0.15 ppm, determine the emission reduction needed to provide for attainment of the Ox standard.

(1) From Appendix J for 0.15 ppm, a 50% reduction in organic emissions is needed.

(11) $50\% \times \text{base year emissions} = (E_R) \text{ emission reduction needed. } 0.50 \times 50,000 \text{ tons} = 25,000 \text{ tons reduction in existing emissions needed to provide for attainment.}$

STEP 8: Determine the future growth of emissions of organic compounds (E_G) in 5-year increments generally over the next 20 years; this period and the increments may be less in certain cases; see 40 CFR 51.42 published in the Federal Register of May 3, 1976 at 41 FR 18382.

Various guidelines have been prepared with regard to obtaining and projecting growth in emissions and allocating such growth. The techniques presented therein are too detailed to summarize here. The reader is referred to the following volumes of the Guidelines for Air Quality Maintenance Planning and Analysis.

- (a) Vol. 7, Projecting County Emissions, EPA 450/4-74-008.
- (b) Vol. 13, Allocating Projected Emissions to Subcounty Areas, EPA 450/4-74-014.

An excellent synopsis of the entire Air Quality Planning process is found in the Air Quality Analysis Workshop: Volume 1 - Manual, EPA 450/3-74-080-a, November 1975. Growth of stationary and mobile sources should be obtained on the most detailed level available commensurate with resources and other aspects of SIP development. Because of the areawide nature of photochemical oxidant which exists due to the time required to form ozone/oxidant, allocation of organic emissions to subareas is not as critical as suballocation might be for other pollutants, hence it is generally not necessary. Subregional allocation is useful, however, in determining the geographic impact of the control strategy.

STEP 9: Determine the organic compound emission reduction necessary to attain and maintain the NAAQS for oxidant. Adding the required emission reductions (E_R) obtained in Step 7 and the growth in emissions (E_G) determined in Step 8 provides the total reductions (E_{TR}) necessary to attain and maintain the standard over the time period considered.

$$E_{TR} = E_R + E_G$$

STEP 10: Determine whether existing emissions will be reduced by source compliance with already adopted control regulations.

(a) Consider the impact of the FMVCP over the time period (see page III-B-11 for discussion of vehicular emission rates for light-duty motor vehicles to be used prior to Congressional action.)

(b) Consider the impact on organic emissions (both increases and decreases) that may result from (1) compliance with adopted organic emission control regulations, or the regulations adopted primarily to minimize emission of another pollutant but which may have an effect on organic compound emissions, such as various transportation control measures (TCM) or Inspection/Maintenance (I/M) programs for CO that may increase or reduce organic compound emissions and (2) ESECA or other fuel switches that may increase or reduce organic emissions.

STEP 11: When additional controls are needed to provide for attainment and maintenance of NAAQS, consider the application of available control measures.

Specifically the control strategy should consider where needed (1) the full range of achievable stationary source controls for the urban area as a minimum; and (2) all reasonable transportation control measures (including an Inspection and Maintenance Program) for the central city and for adjacent areas of high vehicle density where these controls can be effective. See Section III-C for description of achievable controls for mobile-related and stationary sources. To the extent possible alternative control strategies should be developed and tested. The strategy selection should be made on the basis of adequacy of achieving desired goals as well as on the effectiveness and implementability of the various control schemes.

STEP 12: Considering the type of controls that are needed for attainment of NAAQS, determine the most expeditious date when NAAQS can be attained. This shall be within 3 years except in certain specific cases. If it is found that the application of all available control technology will not result in attainment, application of all available control technology must proceed as expeditiously as practicable. As other measures become available, they must be applied also.

III

QUESTIONS FREQUENTLY RAISED CONCERNING PHOTOCHEMICAL OXIDANT

Factors that are of interest and which should be considered in the development of a control strategy for photochemical oxidant are presented in the following pages in question and answer format. Most of the answers are brief; however, one or more references are generally provided for more specific information. In some cases, copies of the more pertinent references are included in Section IV of this manual. The questions/answers are subdivided by topic. Topics are discussed in the following order:

<u>Sub-Chapter</u>	<u>Topic</u>	<u>Pages</u>
III-A	Attainment of National Standards	III-A-1 to III-A-3
III-B	Control Strategy Development	III-B-1 to III-B-14
III-C	Control Technology for Sources of Organic Compound Emissions	III-C-1 to III-C-20
III-D	Air Quality Monitoring for Photochemical Oxidant	III-D-1 to III-D-7
III-E	Emission Data	III-E-1 to III-E-7
III-F	Chemistry of Photochemical Oxidant	III-F-1 to III-F-7

III-A

- ATTAINMENT OF THE NATIONAL STANDARDS -

QUESTION - Is there a national ambient air standard for hydrocarbons?

Must it be attained?

ANSWER - The Agency promulgated an ambient air quality standard for non-methane hydrocarbons. Theoretically it represented EPA's judgment of the maximum level of non-methane HC that would not cause a violation of the 0.08 ppm oxidant standard under optimum conditions of sunlight and NO_x . However, EPA has historically based the need for HC control on the magnitude of the oxidant problem rather than on the hydrocarbon concentrations in the air. State implementation plans (SIP's) are not required to meet the hydrocarbon "guideline", nor does EPA require measurement of hydrocarbons in the ambient air. However, where monitors are available, ambient hydrocarbon data can provide valuable information. The hydrocarbon guideline need not be considered for purposes of control strategy decisions.

QUESTION - What is the National Ambient Air Quality Standard (NAAQS) for photochemical oxidant?

ANSWER - The NAAQS for photochemical oxidant is 160 micrograms per cubic meter (0.08 ppm) - maximum 1-hour concentration not to be exceeded more than once per year as measured by the Federal Reference Measurement Principle and Calibration Procedure (FRM).

ADDITIONAL INFORMATION - (1) Code of Federal Regulations, Title 40 - Protection of Environment, Subpart C - Air Programs, Part 50 - National Primary and Secondary Ambient Air Quality Standards, Section 50.9 codified from Volume 36 of the Federal Register, page 22384 dated November 25, 1971, (2) Air Quality Criteria for Photochemical Oxidants - AP-63.

QUESTION - Is the NAAQS for oxidant valid?

ANSWER - Yes, it was based upon the best available information at the time of promulgation. Continuing study and reevaluation of the standard is proceeding, however recent studies have found no basis for revising the standard. A report by the National Academy of Science (NAS) to Congress, September 1974, stated, "In general, the evidence that has been accumulated since the promulgation of the Federal ambient air quality standards by the EPA Administrator on April 30, 1971, supports those standards. Hence, on balance, the (NAS) panels found no substantial basis for changing the standards."

A recent report by the World Health Organization also reached the following conclusion.

It is apparent that any primary protection standard between .05 and .10 ppm will provide the narrowest margin of safety against some possible detrimental effects in the more susceptible segments of the population. There would seem to be little justification for exceeding .10 ppm for a primary protection standard, and the fact that the threshold limit value for occupational exposures in the United States is .10 ppm should reinforce the conclusion that this is the upper limit for a primary protection standard for the general population.

ADDITIONAL INFORMATION - (1) NAS Report to Congress, "Health Effects of Air Pollutants," Serial 93-24, Volume 2; Sept. 1974. (2) The Health Implications of Photochemical Oxidant Air Pollution to Your Community; EPA 450/2-76-015 (Aug. 1976). (3) Environmental Health Criteria for Photochemical Oxidant, World Health Organization, Draft Report EHE/EHC/WP/75.5, March 20, 1975.

III-B

- CONTROL STRATEGY DEVELOPMENT -

QUESTION - For what reasons must SIP's be revised?

ANSWER - Section 110(a)(2)(H) of the Clean Air Act, as amended requires that SIP's provide "for revision, after public hearings, of such plan (i) from time to time as may be necessary to take account of revisions of such national primary or secondary ambient air quality standard; or the availability of improved or more expeditious methods of achieving such primary or secondary standard; or (ii) whenever the Administrator finds on the basis of information available to him that the plan is substantially inadequate to achieve the national ambient air quality primary or secondary standard which it implements."

QUESTION - What is Agency policy regarding requests for State Implementation Plan (SIP) revisions to attain and maintain the NAAQS for photochemical oxidant?

ANSWER - One major air activity in FY 1976 was the review of all SIP's to identify those which are substantially inadequate for attainment and maintenance of national standards.

The results of these activities have been consolidated in calls for plan revisions issued by the Regional Administrators in July, 1976. These calls for revision addressed areas in which the SIP was found to be substantially inadequate for attainment.

SIP revisions for oxidant must be submitted by July 1, 1978. This submission ought to include (1) a control strategy, (2) emission limit regulations for industries, (3) transportation measures that are currently practicable. However, in areas where attainment is not demonstrated, the states should be made aware that their SIP is not fully approved and that additional measures must be submitted as soon as an adequate technical basis is developed. This will include (1) RACT for all industries where possible and (2) many additional transportation measures. In many areas, the application of all the measures outlined above will not result in attainment and maintenance of the oxidant standard. In these areas, the SIP will need to be revised periodically to include additional control as technology improves and new transportation and land use measures become feasible.

ADDITIONAL INFORMATION - (1) Nov. 12, 1975, Memo from Roger Strelow/Stan Legro to All Regional Administrators, Subj: Agency Policy Regarding Calling for Plan Revisions to Approved State Implementation Plans that are Substantially Inadequate to Attain National Standards; (2) Mar. 16, 1976, Memo from Roger Strelow to Regional Administrators, Subj: Regional Air Quality Attainment/Maintenance Activities; (3) Guidelines for Determining the Need for Plan Revisions to the Control Strategy Portion of the Approved State Implementation Plan, OAQPS 1.2-011 (Revised).

QUESTION - How frequently should plans be updated to reflect new information with respect to air quality measurements, emissions data and modeling techniques?

ANSWER - In cases where the adopted control strategy is clearly inadequate to attain national standards for photochemical oxidant, the plan should be revised as new technology becomes available. Efforts are currently underway within OAWM to define this technology for both mobile and stationary sources of organic emissions. In those cases where the plan is believed adequate to attain national standards or is marginally inadequate to attain national standards, it may be prudent to delay new calls for SIP revisions until the impact of full implementation of the control strategy can be assessed.

QUESTION - How much ambient air quality data are necessary to serve as a basis for a control strategy?

ANSWER - One oxidant season of data from at least one monitoring station is generally needed, but where possible three or more years of monitoring data should be examined prior to defining a SIP design value. While it is beneficial to have many years of data at numerous sites, the development of a control strategy should not be postponed if minimal valid data exist that indicate substantial violations of the national standards.

Measured data, not statistically derived concentrations should be used as the basis of the control strategy. When using any oxidant air quality data, it should be remembered that the late spring to early

fall period is the most important when assessing the adequacy of a plan for oxidant. While violations of the oxidant standard may be observed at other times of the year, they are generally not of the frequency and magnitude of violations observed during the summer.

QUESTION - Why should measured data, rather than statistically generated second maximum one-hour concentrations be used for photochemical oxidant control strategy development purposes?

ANSWER - Occasions of peak concentrations are relatively infrequent and may result from non-typical conditions. Because of the nature of these events, they are generally unpredictable. Use of statistical techniques to predict infrequent short-term events is not technically sound. While statistical techniques are generally useful in predicting long-term averages, the precision of such techniques for predicting short-term peak situations is limited. A statistical technique might predict the maximum for an "average" year but the confidence interval on such a prediction would be broad and the interpretation of an average year is somewhat vague. Further, from a practical point of view, valid measured data can provide a sound legal basis for control purposes. Though it is true that measured data will generally not exist for every hour within a year, and that some probability exists for not measuring worst case conditions, use of properly maintained continuous monitors for measuring ambient photochemical oxidant concentrations can provide data for well over 80% to 90% of the hours within a year. Hence, it can be reasonably expected that worst case conditions will be measured.

Even if peak conditions are not measured, use of available measured data are more defensible and generally more acceptable than statistically generated data. Additionally, due to the precursor-pollutant relationship it is difficult to predict the necessary values.

QUESTION - What meteorological data should be considered in determining representative ambient photochemical oxidant concentrations?

ANSWER - At the present time, meteorological parameters cannot be explicitly considered in recommended source/receptor relationships. Models are now under development that may provide a mechanism to consider transport and other meteorological factors, however until these methods are available, such parameters cannot be explicitly considered.

QUESTION - What geographic area should be considered in the control strategy? Should control strategies include broad geographic areas such as entire AQCR's, multi-AQCR's?

ANSWER - While it is true that high ambient levels of photochemical oxidant are observed over broad areas of the nation, at the present time it is recommended that the control of organic emissions be centered primarily in urban areas. EPA believes that much of the high rural levels of oxidant are caused by transport of urban oxidant and precursors. Hence for areas where the SIP has been determined to be substantially inadequate, the metropolitan area should be the primary area of concern since these areas generally have the highest concentrations and also contribute significantly to the area-wide problem. Additional guidance will be forthcoming to assist in the determination of the area size that should be considered for control. Reducing emissions in these areas will minimize oxidant concentrations in the urban and surrounding areas and will minimize transport of oxidant and its precursors to more rural areas.

ADDITIONAL INFORMATION - Control of Photochemical Oxidants - Technical Basis and Implications of Recent Findings, July 75, EPA-450/2-75-005.

QUESTION - What is the definition of rural and urban areas?

ANSWER - The distinction between rural and urban areas for control of oxidant is difficult to establish. Guidance will be provided in the near future on how to make this determination. It appears that the criteria will be based on examination of the area population, NMOC/NO_x ratio, and ambient levels of NO_x.

QUESTION - Should AQCR boundaries be modified for photochemical oxidant due to the transport phenomena of photochemical oxidant?

ANSWER - No. While there is evidence of long-range transport, many questions exist about the extent and origin of transported oxidant and its precursors. More important is the question of how to minimize existing violations of the photochemical oxidant standards. Recognition of transport and acceptance of responsibilities for contribution to downwind concentrations is essential. Interstate and intrastate coordination is necessary on the transport question regardless of AQCR boundaries. Further, any geographic area can be used as the basis of a control strategy, e.g., more than one AQCR, or less than one complete AQCR.

QUESTION - Is the Appendix J calculation still the required method of determining the degree of organic emission control needed to attain the O_x standard?

ANSWER - Appendix J, based on non-methane organic compounds, is still acceptable and is the standard method; it is acceptable to replace it

with a different technique using local data with adequate documentation. Although Appendix J was the best possible approach in 1971, it clearly is not adequate for a number of situations. EPA is evaluating several models and during early 1977 will publish the results of the review and suggest possible alternatives to Appendix J. These alternative models will attempt to accommodate transport and the effects of NO_x . For immediate decisions the use of Appendix J modified by proportional rollback for O_x levels greater than 0.28 ppm is recommended if local data are not available (see Section II., Step 7).

ADDITIONAL INFORMATION - (1) An alternative to the Appendix J method for Calculating Oxidant - and NO_2 - Related Control Requirements, Dr. B. Dimitriadis; (2) The Use of Trajectory Analysis for Determining Empirical Relationships Among Ambient Ozone Levels and Meteorological and Emissions Variables, Dr. E.L. Meyer, et al.; (3) Combined Use of Modeling Techniques and Smog Chamber Data to Derive Ozone Precursors Relationships, Dr. M.C. Dodge. NOTE: All of the above papers were presented at the International Conference on Photochemical Oxidant Pollution and its Control, Sept. 17-22, 1976, Raleigh, N.C.

QUESTION - Should ambient background concentrations of photochemical oxidant due to emissions from natural sources be considered in the development of a control strategy, and if so, how?

ANSWER - At the present time, no method exists to explicitly consider ambient natural background concentrations of photochemical oxidant in

the control strategy. Natural background levels of oxidant due to natural sources occur on some occasions in the range of 0.04 to 0.05 ppm. Some of the natural sources of organics include vegetation, biological action, geothermal areas, coal fields, natural gas and petroleum fields and natural fires. Natural ozone may also be of stratospheric origin, however, its contribution to overall ozone levels during periods of high ozone concentrations is minimal.

It is believed that the contribution of natural sources is generally small in urban areas in relation to peak oxidant concentrations. Not explicitly considering background concentrations in the control strategy will tend to underestimate the degree of control needed to provide for attainment and maintenance.

ADDITIONAL INFORMATION - (1) R.M. Angus and E.L. Martinez, Rural Oxidant and Oxidant Transport, presented at the Conference on State-of-the-Art of Assessing Transportation Related Air Quality Impacts, Oct. 22, 1975, (2) Control of Photochemical Oxidants - Technical Basis and Implication of Recent Findings - July, 1976, EPA-450/2-75-005, and (3) Air Quality Criteria Document for Hydrocarbons, AP-64.

QUESTION - Should transport of oxidant and its precursors be accounted for in the development of a control strategy?

ANSWER - Ideally, yes, but unfortunately at the present time there is no available procedure or analytical method available to adequately consider transport in a control strategy. EPA is presently attempting to develop alternatives to Appendix J which may include the effects of transport of oxidant and its precursors. In the interim, only a limited consideration of transport can be made. For example, transport may be considered in a limited way by using measured air quality data observed at a distance of 10 to 30 miles downwind of the urban area, rather than data within the urban area itself. Depending upon the meteorological conditions on the day in question, such data will probably represent air quality resulting from the upwind urban emission sources rather than local sources. In addition, it may be possible in those cases where ambient monitors are available in upwind and downwind locations to quantitatively determine the impact of emissions from urban areas on air quality. However, because of the complexity of the chemistry and meteorology involved, such assessments, though noteworthy, may not provide precise definitions of transport. It should also be noted that EPA believes that the urban control strategy will have a significant effect on the amount of oxidant and precursors transported.

QUESTION - What, if any, is the impact of fuel switching due to ESECA?

ANSWER - The impact of ESECA in relation to organic emissions is relatively minor. Only 1/4% of the total U.S. organic compound emissions are from utilities. Modification of oil-fired to coal-fired boilers should give only a minor increase in organic emissions (i.e., from 0.30 lbs. to 0.36 lbs. per 12,000 BTU thermal heat input). Gas to coal conversion would result in increased organic emissions from

0.025 lbs. to 0.36 lbs. per 12,000 BTU thermal heat input. For a 500 MW plant a conversion from gas to coal could result in an increase from approximately 10 tons/year to 140 tons/year, assuming all boilers were converted, which is unlikely. This total is small compared with total organics emitted within an area.

QUESTION - To what extent does growth information employed in plan development for attainment and maintenance have to be internally consistent and coordinated with other planning programs?

ANSWER - Growth projection applied to various emission source categories must be internally consistent, i.e., projection developed for use in assuring maintenance of the NAAQS must be consistent with the usually more limited projections used to plan for the attainment of the NAAQS. These projections must also be consistent with 208 area-wide waste treatment planning as well as "3-C" planning done in the urban area. This kind of consistency can usually be assured by determining which source of growth information has the most reliable information and then using that source for all emission projection tasks.

The level of detail available for emission projection purposes is variable within selected source categories. For example, mobile source emissions may be estimated for a projection year by calculating emissions by the procedures in Volume 7 or 13 of the AQM Guidelines using (1) VMT projections on a transportation link specific basis, (2) total county VMT projections derived from motor vehicle registrations, or (3) projected countywide fuel use usually based on population growth.

Selection of the level of detail necessary to project growth for specific emission source categories should be governed by the importance of that source to the air quality problem at hand and consideration of what kinds of controls and interagency coordination might later be required. For example, use of link specific VMT projections obtained from the area's transportation planning agency through the regional (comprehensive) planning agency, while assuring a common data base for air, land use and transportation planning purposes, also provides a means, because of its specificity, to indicate possible implementable air pollution controls through changes in urban land use, the transportation network, or vehicle use patterns.

QUESTION - What effect will the amendments to the Clean Air Act have on automobile emissions rates for organic compounds?

ANSWER - Several different proposals were considered by the 94th Congress (Table 1) that would alter the existing date (1978) of implementation of the 0.41 gram/mile hydrocarbon emission limitation for automobiles. The proposals in Table 1 represent those under consideration by Congress in April 1976. Until specific action is taken to amend the law, it is recommended that the controls currently mandated by the Act be used for planning purposes. These are included in Table 1 under the column heading "Existing."

While there may be some changes in the effective date of emissions reductions for automobiles, any delay of the nature indicated in Table 1 will not have a significant impact in the overall control strategy due to the low rate of vehicle turnover and the fact that emissions have already been considerably reduced.

An overall composite motor vehicle emission projection from 1970 to 1995 considering a 3% annual VMT growth rate, applicable motor vehicle emission standard, and standard conditions is presented in Figure 1.

TABLE 1
PROPOSED HYDROCARBON AUTOMOBILE EMISSION STANDARDS
(gm/mile)

Effective Year	Existing	Dingell Amendment	House Sub-committee	Senate	House Report	Administration Proposal
1977	1.5	1.5	1.5	1.5	1.5	1.5
1978	0.41	1.5	0.9	1.5	1.5	1.5
1979	0.41	1.5	0.9	0.41	1.5	1.5
1980	0.41	0.9	0.41	0.41	0.41	1.5
1981	0.41	0.9	0.41	0.41	0.41	1.5
1982	0.41	0.41	0.41	0.41	0.41	0.41

DATE: April, 1976

QUESTION - Recently, it has been noted that evaporative emissions from automobiles are much higher than originally estimated. What action is being taken to control this source of organic emissions?

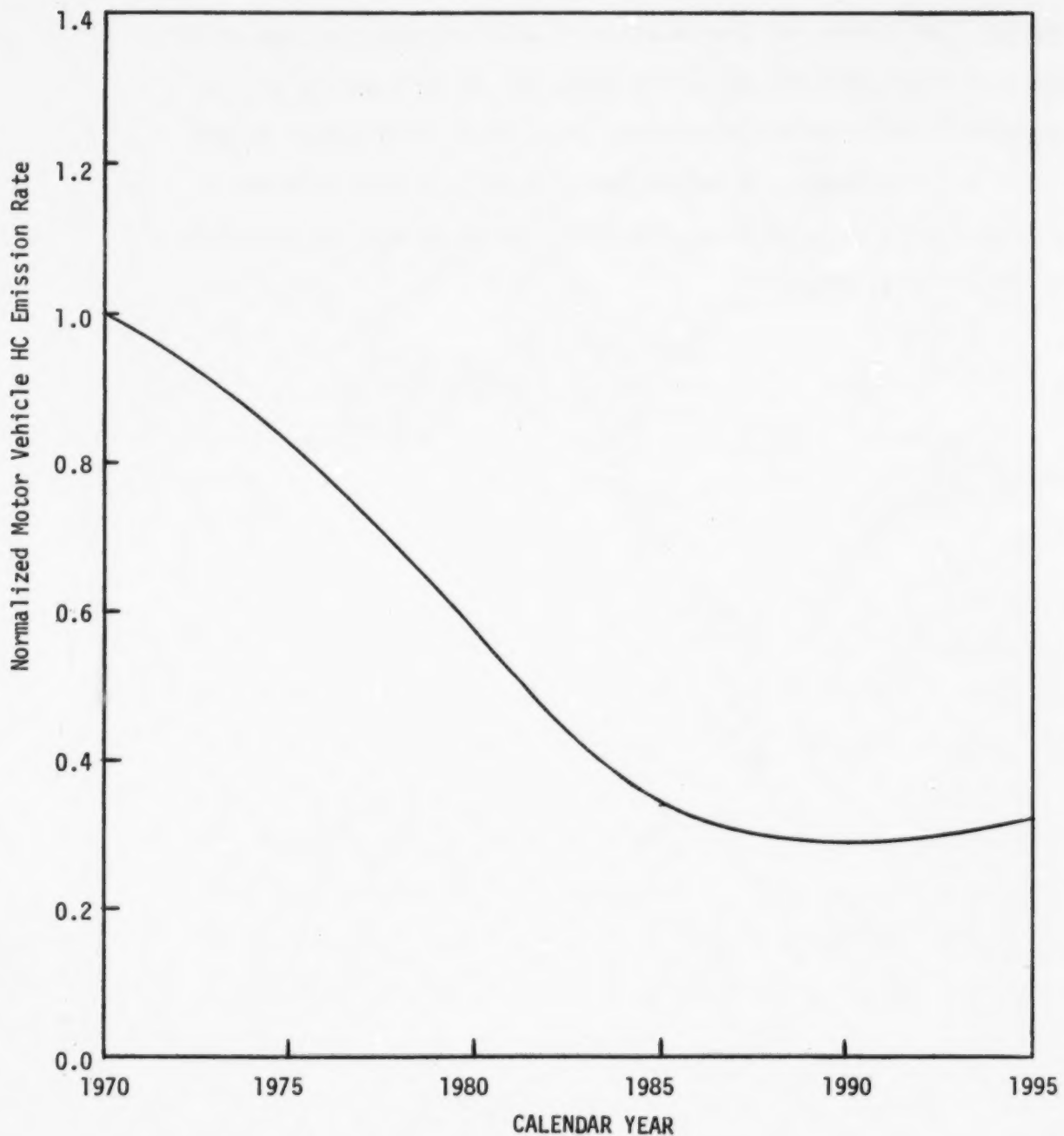
ANSWER - On August 23, 1976, EPA promulgated regulations requiring 70% control of evaporative emissions from light duty vehicles and trucks. The new regulations and associated test procedures will reduce evaporative emissions from these vehicles from 1.76 gm/mile to 0.6 gm/mile in 1978. These reductions should be accounted for in SIP development.

ADDITIONAL INFORMATION - Federal Register, Vol. 41, August 23, 1976, page 35626.

QUESTION - It has been reported that the 1975 and 1976 model automobiles are deteriorating at a higher rate than initially indicated, how should this be taken into account?

ANSWER: The increase of deterioration of emission rates for automobiles has been noted primarily for carbon monoxide. While there has been an increase in emissions of hydrocarbons the increase in emissions is generally not significant. A new supplement to AP-42 will be released shortly and the emission rates given there should be used for calculating automotive emissions.

FIGURE 1
NORMALIZED MOTOR VEHICLE EMISSIONS RATE FOR HC



Assumption:

1. National average automobile and truck age distribution
2. Low altitude, standard conditions
3. 3% Compounded (annual) growth rate
4. National average vehicle mix (LDV 80.4%; LDT 11.8%, HDG 4.6%; HDD 3.2%)
5. 1970 composite emission factor 12.4 g/mi
6. Based on Emission Factors in Compilation of Air Pollution Emission Factors, AP-42, according to current Federal Law.

III-B-14

JAN 1977

III-C

- CONTROL TECHNOLOGY FOR SOURCES OF ORGANIC COMPOUND EMISSIONS -

QUESTION - What is "Reasonably Available Control Technology" (RACT) for stationary sources, and how is it determined for an individual source?

ANSWER - As part of the original SIP development in 1971 and 1972, the concept of RACT was expressed as a series of examples of emission limitations attainable by various source classes and was published in Appendix B of 40 CFR 51. This original concept is obsolete, for several reasons. First, it is now realized that the many individual physical specifications of plants cannot be covered by a rigid "one-number" approach. Controls that may be achievable for a source in one area may not be achievable for a similar source in another area because of variations in the process, the lack of space to retrofit the controls, or the like. In other instances, if an attempt is made to apply the same emission limit to all sources regardless of the specific situation, one may inhibit the application of better controls that may be quite achievable for a specific source at a specific location. Further, it is the air quality that determines the degree of control necessary in order to attain the NAAQS. Thus, similar sources may be treated differently in different areas because the reductions in air quality necessary to meet the NAAQS will vary, depending on the severity of the air quality problem. In some instances, the SIP may not require controls that are at the limit of achievable technology. There are, of course,

situations where the amount of control required to meet the NAAQS is clearly beyond the limit of achievable technology. In such cases, the SIP is limited to achievable control measures. But even in such situations what is achievable in one area may or may not be achievable in another area. For these reasons, a flexible procedure for determining the RACT for various areas is appropriate.

With respect to individual point sources with defined emission points (i.e., those amenable to the application of "classical" control equipment), reasonably available control technology (RACT) defines the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. RACT may represent a relatively stringent, or even "technology forcing," requirement that goes beyond simple "off-the-shelf" technology.

ADDITIONAL INFORMATION - Strelow, R., to All Regional Administrators, memorandum, Guidance for Determining Acceptability of SIP Regulations in Non-Attainment Areas, December 9, 1976.

QUESTION - Which organic compounds react in the photochemical oxidant process and what is the Agency's approach to controlling organic emissions?

ANSWER - Originally it was believed that some organic compounds react to produce ozone while others do not. It has since been determined that virtually all organics react to produce ozone if irradiated with

ultraviolet light for a long enough period. Hence in order to provide for attainment of the photochemical oxidant standard, it will generally be necessary in most urban areas to control all man-made non-methane organic compounds.

QUESTION - Specifically, what regulations for the control of organic compounds from stationary sources are available at the present time?

ANSWER - Part 51, Appendix B, originally represented the Agency recommendation with regard to organic control. However, experience has shown several deficiencies in Appendix B, particularly in the area of organic compound emissions. These include (a) provisions which require clarification, (b) provisions which contain inadequately defined source categories, and (c) provisions which are obsolete. Appendix B therefore no longer represents Agency policy regarding achievable controls for hydrocarbon sources and it is being modified to remove specific limitations. A policy statement will be substituted for the current Appendix B.

At present, EPA is investigating regulatory controls for non-methane organic emissions from coating operations from existing plants in the following industries: (1) paper, (2) fabric (coating and rubberizing), (3) assembly of autos and light trucks, (4) cans, and (5) coils. Copies will be distributed to the Regional Offices shortly as part of the OAQPS Guideline Series. In addition, similar work has begun on the following industries: (1) film and foil coating, (2) degreasing, and (3) dry cleaning.

Additionally, Stage I and Stage II controls on gasoline marketing can provide up to a 90% decrease in organic compound emissions from those sources affected.

QUESTION - If it is known that control of all types of non-methane organic compounds will generally be necessary to provide for attainment of the oxidant standard, why does the Agency encourage the use of substitution type regulations?

ANSWER - Control technology to minimize all NMOC emissions to acceptable levels is not reasonably applicable to all sources or has not been specifically defined for all sources at this time. In the interim, substitution of lesser reactive organics for more reactive organics should reduce oxidant within the general area around the emitting sources.

QUESTION - What are considered available controls for transportation related sources?

ANSWER - The Office of Transportation and Land Use Policy in a January 9, 1976, Guideline on Policies for the Inclusion of Carbon Monoxide and Oxidant Controls in State Implementation Plans identified reasonable transportation measures for SIP's. Included in those measures deemed

reasonable are (1) Inspection/Maintenance, (2) Vapor Controls for Gasoline Marketing, (3) Heavy Duty Vehicle* (HDV) Retrofit, (4) Transit Improvements, (5) Employer Incentives, (6) Parking Management/Restrictions, (7) Traffic Management/Restrictions, and (8) Ship and Barge Controls. Two measures listed as not reasonably available were gasoline rationing and retrofit for light-duty vehicles.

Further, both houses of the 94th Congress endorsed the following additional land use and transportation type measures for the control of auto-related pollutant emissions:

- (i) motor vehicle emission inspection and maintenance programs;

- (ii) programs to control vapor emissions from fuel transfer and storage operations and operations using solvents;

- (iii) programs for improved public transit;

- (iv) programs to establish exclusive bus and carpool lanes and areawide carpool programs.

ADDITIONAL INFORMATION - Policies for the Inclusion of Carbon Monoxide and Oxidant Control in State Implementation Plans, Office of Transportation and Land Use Policy, Jan. 9, 1976.

QUESTION - What reduction in NMOC's is expected to occur from the implementation of various Transportation Control Measures?

ANSWER - Transportation measures such as mass transit, carpool incentives, etc., will reduce organic compound emissions, and these reductions should be accounted for in the oxidant strategy.

*A heavy duty vehicle (HDV) is any vehicle in excess of 8500 lbs. gross vehicle weight.

Auto-use and emissions reductions achieved by transportation controls derive from the effects of the entire group of measures included in a transportation control plan, rather than the effects of individual measures. Moreover, the effectiveness of specific auto-use reduction approaches is strongly dependent on local conditions. Hence in any consideration of oxidant reductions identified with specific control measures, it is necessary to view these reductions as rough estimates which are subject to change when placed in the operating framework of the entire TCP for a particular area.

Several control measures (such as retrofit and inspection/maintenance) are available to reduce emissions from in-use vehicles. Since these control measures require that individual vehicle emissions be reduced by a certain amount, it is relatively easy (when compared to VMT reduction measures) to quantify emission reductions that may result from the implementation of these control measures.

The maximum VMT reductions from transportation measures will result from coordinated measures designed to discourage low occupancy auto use and to encourage transit and carpool use. However, transit and carpool incentives by themselves are insufficient for achieving significant emissions reductions. Programs that do not incorporate parking restrictions, surcharges, or other disincentives are unlikely to achieve emission reductions greater than 5 to 10 percent.

ORGANIC EMISSION REDUCTION MEASURES

<u>Measure</u>	<u>Impact on Emissions</u>	<u>Reference Number</u>
1. Inspection/Maintenance	Up to 15% decrease	(1)
2. HDV Retrofit	Up to 85% decrease (Catalyst w/air pump and EGR)	(2)
3. Gaseous fuel conversion	Up to 60% decrease	(2)

References:

- (1) 40 CFR 51, Appendix N (currently being revised).
- (2) Review of Control Strategies for In-Use Vehicles, EPA Contract Report - EPA 460/13-74-021, Dec. 1974.

QUESTION - What are the costs associated with Inspection/Maintenance programs?

ANSWER - The following is an estimate of the cost associated with Inspection/Maintenance Programs during 1975-76.

FIXED AND OPERATING COSTS OF A TWO-LANE INSPECTION STATION

EMISSIONS ONLY

**CENTRALIZED PUBLIC FACILITY
(dollars)**

FIXED COSTS	Loaded	Idle
Equipment		
Analyzers (3, w/CO, HC, CO2 and digital readout)	20,000	20,000
Dynamometers (2)	13,000	--
Site Costs (approx. 30,000 ft ² required)	20,000-140,000	20,000-140,000
Construction	80,000	70,000
Administrative Startup and Miscellaneous	7,000	7,000
Extras: Computer Systems, Ignition Analyzers		
Total Fixed Cost	140,000-260,000	117,000-237,000
ANNUAL COSTS		
Annualized Capital Cost	21,950- 34,050	17,380- 29,480
Operating Costs		
Salaries (5 inspectors, 1 supervisor @ 8 hrs/day, 300 days/yr)	80,000	80,000
Supplies	2,940	2,940
Overhead and Administrative Support	37,110	33,680
Total Annual Cost	142,000-154,100	134,000-146,100
COST PER VEHICLE		
Design throughput, tests/year/lane	32,000	50,000
Design throughput, vehicles/year/lane (assumed 30 percent failure rate)	24,000	38,000
Cost per registered vehicle	\$2.96 - 3.21*	\$1.76 - 1.92*

*These costs cover only the basics of building and operating stations, and do not include such highly desirable items as public relations, data analysis, mechanic training, research, capital expansion as required, etc.

FIXED AND OPERATING COSTS OF AN EMISSIONS INSPECTION STATION

	PRIVATE GARAGE IDLE MODE (dollars)	Alone	w/existing safety
CAPITAL COSTS			
Equipment - Infrared Analyzer ^{1/}		2,000	2,000
Contingencies and miscellaneous		200	200
Total Capital Cost		<u>2,200</u>	<u>2,200</u>
ANNUAL COSTS			
Annualized capital cost (5 yrs. @ 10%)		580	580
Salaries		2,000	1,000
Supplies		420	420
Total Annual Cost		<u>3,000</u>	<u>2,000</u>
ANNUAL COST TO LOCAL GOVERNMENT FOR PRIVATE GARAGE I/M, per one million vehicles (costs of scale should be considered for different size populations)			
Administration		75,000	50,000
Enforcement		104,000	69,000
Annualized Capital Cost		14,500	10,000
Space Leasing, Contingencies, etc.		6,500	1,000
Total Annual Cost to Local Government		200,000	130,000
Per Vehicle Cost		\$0.20	\$0.13

Extras: Mechanic Training (approx. \$60,000 per million vehicles)
and certification of Repair Facilities

^{1/} With average thrupt per station of about 5 vehicles per day,
one analyzer can easily cover up to three bays.

Maintenance Cost Guide

- Assumptions:
- a.) Costs applicable to 1976. Data base has been adjusted for inflation.
 - b.) 3/4 of repairs are performed by commercial facilities, and 1/4 by do-it-yourselfers.
 - c.) No credit taken for repair that would be performed as part of a normal maintenance regimen.

BASIC TABLE

Total* Failure Rate	Cost per Serviced Vehicle
10%	\$33.00
20%	\$29.00
30%	\$26.00
40%	\$24.00
50%	\$23.00

*Percentage of vehicles rejected for HC, CO, or both.

Conditions of Basic Table:

- a.) Idle Test
- b.) Proportion of all rejected vehicles failing for excessive hydrocarbons is 0.35 (normal for most programs)
- c.) Maintenance must be mandatory

Adjustments to Basic Table:

- a.) Loaded test--add three dollars to Basic Table values
- b.) Hydrocarbon repair adjustment--

x = proportion of all rejected vehicles failing for HC

y = adjustment factor (multiply by basic idle or loaded repair cost).

x	0.0	0.1	0.2	0.3	0.4	0.5	0.75	1.0
y	0.3	0.5	0.7	0.9	1.1	1.3	1.7	2.0

- c.) Fleetwide Cost per vehicle--multiply Cost per Serviced Vehicle by Total Failure Rate

Example: A planned I/M program is to be loaded-mode, with an estimated rejection rate of 32 percent, of which the HC failure proportion is 0.2. Find Cost per Serviced Vehicle and fleetwide cost.

Basic Idle Test cost @ 32 percent	\$25.50 (interpolated)
Loaded Test Adjustment -- \$3	\$28.50
HC adjustment (x 0.7)	\$19.90--Cost per
	Serviced Vehicle
Fleetwide Cost per Vehicle (x 0.32)	\$ 6.40

QUESTION - What is the fuel savings due to Inspection/Maintenance programs?

ANSWER -

FUEL SAVINGS FROM INSPECTION/MAINTENANCE PROGRAMS

Failure Rate (x)	Annual Fuel Savings-Serviced Vehicles Only (y) % (gallons)		Dollar Savings per Serviced Vehicle	Annual Fuel Savings-All Vehicles (%) (gallons)		Dollar Savings per Vehicle-All Vehicles
50%	4.2	36	21.40	2.1	18	10.70
40%	4.73	40	24.00	1.89	16	9.60
30%	5.5	47	28.00	1.65	14	8.40
20%	6.76	57	34.40	1.35	11	6.85
10%	9.66	82	49.30	0.97	8	4.90

All savings based on national averages of 11,500 vehicle-miles per year and 13.58 mpg. Cost of fuel assumed at \$0.60 per gallon.

These estimates are based on the most extensive and reasonable data presently available to EPA: the Olson Short Cycle Tests, as reported in Section 2.6.2.2 of "A Review of Control Strategies for In-use Vehicles." An exponential function (resulting in the above table) relating annual fuel savings for serviced vehicles to failure rate was derived, based on HC and CO curves from the Olson Short Cycle Tests:

$$y = 31.5(x)^{-0.514}$$

Table figures are derived from tests on both pre-control and post-control vehicles.

Other, more liberal, results on fuel economy are available, including those from the IUCP program, New Jersey Bell Telephone, the New York Taxicab Study, etc.

The Olson Degradation Study (144 vehicles, January 1975 population) showed an annual fleetwide fuel savings of 3.02 percent at 41 percent failure rate (OTLUP analysis).

QUESTION - What operational experience has been gained with Inspection/Maintenance programs?

ANSWER - The following pages give pertinent facts concerning various Inspection and Maintenance programs in New Jersey and Arizona. Additional information sheets are included in Section IV for Cincinnati and Hamilton County, Ohio; Chicago; Portland, Oregon; and Riverside, California.

Location: New Jersey

Type of Program: State operated permanent facilities, idle mode, mandatory inspection and maintenance. Includes safety inspection. Failed vehicles may be retested at certified private garages.

Sites: 39 sites, 69 lanes, 1 mobile van (rotates among sites)

Chronology: Inspections began July 1972, with voluntary maintenance phase. Fully mandatory program commenced Feb. 1, 1974, with Phase I standards. On Nov. 1, 1975, Phase II standards became effective, and private garage reinspection began a two-year trial period. Also beginning on this date, new cars were withheld from inspection for their first two yearly re-registrations.

Geographic Coverage: Entire State of New Jersey (3.8 million LDV's)

Administering Agency: New Jersey Department of Environmental Protection (establishes standards and technical procedures), Department of Motor Vehicles (administers testing and enforces standards).

Capital Cost: \$250,000 for analyzers and related equipment-inspection facilities already in operation for safety.

Operating Cost: DEP, \$330,000/yr
DMV, \$464,000/yr, 20% of which is "fringe benefits"
Total \$794,000/yr

Cost to Motorist: \$1.00 taken out of yearly registration fee, includes safety. \$1.00 additional fee at reinspection garages.

Standards/Failure Rate: Phase I - approx. 12 percent rejection
Phase II - approx. 20 percent rejection
Phase III - approx. 30 percent rejection
All phases are four-stage, dependent on model year.

Enforcement: Vehicle cannot be registered unless inspection is passed.
Enforced by sticker system.

Instrumentation: 125 specially modified Sun "EET 910" analyzers w/ color-coded scales and pass/fail lights.

Data Collection: Response card given to each rejected vehicle. Record kept of failure and refailure rates, cost of maintenance, nature of repair, and type of facility performing repair.. Initial refailure rate of 40 percent has dropped to 18 percent (under Phase I standards). NJDEP also conducts periodic surveillance on groups of 2000 vehicles.

Mechanic Training: Plans to conduct training program at vocational schools. Plans to certify mechanics through NIASE. Exxon has already conducted mechanic training for emissions, affecting about 15 percent of all service stations in State.

Waiting Times: Major delays predated the advent of emission inspection and continued into both emission Phases I and II. Delays cause many vehicles to needlessly fail the CO emissions test because of the "hot idle" effect. These vehicles return to be retested for CO, making waiting lines even longer. Private garage reinspection and the two year exemption for new cars were instituted as a result of excessive waiting times, but have not alleviated the problem thus far. There have been no recent lane capacity improvements in New Jersey.

Problems (other): Two year exemption for new cars means approx. 30,000 miles pass before cars are first inspected. Lack of capital -- capacity improvements cannot be made, instruments cannot be upgraded, programs (mechanic training, etc.) cannot be undertaken. Refailure rate has stabilized at 18 percent.

Achievements: Nation's longest ongoing I/M program. Thirteen percent improvement in ambient CO readings since program began. This reduction is holding. Three thousand garages have installed exhaust analyzers (as of 3/75). This number has risen with the inception of the private garage reinspection program.

Location: Arizona

Type of Program: Contractor operated, permanent and mobile facilities, loaded mode. Mandatory inspection with voluntary maintenance during 1976.

Sites: 12 permanent sites, 36 lanes (9 "metro" stations of 3 to 5 lanes and 3 one-lane stations in outlying areas. One mobile station.

Chronology: Voluntary testing began December, 1975 and became mandatory 1-2-76. Maintenance becomes mandatory January 1977.

Geographic Coverage: Maricopa (Phoenix) and Pima (Tucson) Counties, approx. 1.1 million vehicles including trucks and motorcycles.

Administering Agency: Arizona Department of Health Services
Operated by: Hamilton Test Systems, Inc.

Capital Cost: \$134,000 one-time appropriation by State.
\$9.0 million to HTS, including location studies, administrative start-up, etc., as well as equipment, land acquisition, and construction.

Operating Cost: Est. \$4.5 million by HTS in 1976.

Cost to Motorist: \$5, including one free retest.
The legislature is considering maintenance waiver provisions to accompany the 1977 mandatory maintenance phase.

Standards/Failure Rate: HC and CO standards at low cruise, high cruise, and idle dependent on engine type (2 or 4 stroke), model year (4 stages), curb weight, and number of cylinders. Cruise speeds dependent on vehicle weight and horsepower. 20% opacity standard for diesels. Projected rejection was 35 percent, but 47 percent of vehicles were actually failing in early stages of program. All 50 cc and larger engines are covered, including two-strokes and diesels. Golf carts are exempted. New cars are not inspected until one year old. 15 year and older "moving exemption", e.g., in 1976, model years 1961 and older are exempted.

Enforcement: Vehicles cannot be registered without proof of inspection in 1976, or proof of passed inspection starting in 1977. Proof consists of embossed stamp on registration form by Hamilton.
Under-hood check for tampering and PCV operation.
Besides annual registration, vehicles must also be inspected at title change. Scrap and auction sales, and sales between private individuals are exempted.

Instrumentation: All Otto-cycle vehicles tested on Hamilton infrared (NDIR) exhaust analyzers for HC, CO, and CO₂. Wider range meter for two-stroke engines. Opacity testing for Diesels. Clayton dynamometers. Computer link provides automatic printout of results (no engine hookup as in Riverside).

Data Collection: Vehicle ID information, all test results, lane location, time of day, etc. for all vehicles.

Mechanic Training: ADHS has conducted 2-day seminars for mechanics.

Waiting Times: Some problems experienced at start of program, but these are expected to disappear due to optimizing hours of operation and better public awareness of all station locations. 10 minutes is the planned maximum wait during a typical peak hour.
Total Inspection time is five minutes.

Other Aspects: Of the 5\$ inspection fee, \$0.55 goes to the State. Part of this money is used for its own operating expenses and the remainder is deposited in a special fund to be used for future expansion, contingencies, etc. Hamilton's \$4.45 share of the fee includes profit and program public relations.

Problems: Initial adverse public reaction.
As of mid-February, repeal of program remains possibility.
Lack of stabilized operating hours have caused complaints.

Achievements: Nation's first contractor-operated program keeps cost to State minimal.
Thruput good, with 100,000 vehicles in first 1 1/2 months.
In the November 1976 election the voters of the counties involved approved the I/M program.

QUESTION - What is meant by Stage I and Stage II vapor recovery?

ANSWER - Emissions of organic compounds from gasoline handling and transfer operations result from displacement of vapors above the liquid. For the purpose of control of these vapors, gasoline handling and transfer operations have been divided into three phases:

- (1) Filling of tank trucks at bulk terminals.
- (2) Filling of storage tanks at service stations, and
- (3) Refueling of vehicles at service stations.

Stage I controls are concerned with recovery of gasoline vapors during the first two phases of this operation. During the first phase of this operation, gasoline vapors are displaced by the incoming liquid through a vent pipe. Stage I controls require that the transfer of gasoline not be accomplished unless a recovery system is operational to collect these vapors. These controls must be designed to recover approximately 90%, by weight, of those vapors normally vented to the atmosphere. The system generally consists of a nozzle using two hoses, one for the refilling operation and the other to be connected to the recovery system. The same basic procedure is used during the second phase of operations with the vapors which are displaced from the storage tank being vented to the tank truck for subsequent recovery at the bulk terminal.

Stage II controls apply to vehicle filling and while they generally work on the same principle, collecting displaced vapors, as Stage I controls, there are additional problems involved. While fill spouts

for storage tanks can usually be modified to a standard connection, those on automobiles, trucks, etc., are not uniform and in many cases impossible to modify. Additionally, while most storage tanks have a readily accessible vent pipe for the vapors to escape, most vehicle fuel tanks do not. This means that the vapor must be collected from the fillneck while fuel is being transferred. These two problems have resulted in a variety of collection methods. The vapor balance system requires a tight seal over the tank fillneck and depends upon the displacement of vapor by the fuel entering the tank. One difficulty with this is that the design of the vehicle fillneck varies by car model and year. A second system is called the vacuum assist system. This system uses a vacuum on the recovery system to pull the vapors from the tank rather than depending upon simple displacement. The vacuum assist system also requires a recovery system due to the excess air taken in by the system during vapor recovery.

Stage I controls were promulgated in the Federal Register by EPA for 17 AQCR's on November 8, 1973. Compliance with these regulations was required prior to July 1976. Minor extensions to this date have been granted. Stage II regulations were last proposed on November 1, 1976.

ADDITIONAL INFORMATION - A Study of Vapor Control Methods for Gasoline Marketing Operation: Volumes I & II, EPA 450/3-75-046a, EPA 450/3-75-046b.

QUESTION - What Criteria must be met to ensure that air quality measures are implemented as part of the urban transportation planning process?

ANSWER - Specifically, five criteria must be met to insure that air quality measures are implemented as part of the urban transportation planning process: (1) The metropolitan transportation planning organization should participate in the development or revision of transportation measures; (2) all transportation measures (excluding source control measures, i.e., I/M and retrofit) scheduled for implementation in the next 3 to 5 years should be included in the short-range Transportation Improvement Program (TIP); (3) all measures involving improved transportation system management (e.g., bus priority treatment, parking controls, traffic-free zones) should be included in the Transportation Systems Management (TSM) element of the metropolitan area's transportation plan, regardless of when these measures are scheduled for implementation; (4) each transportation measure must appear in the annual element of the TIP for the year in which the transportation measure is scheduled for implementation; and (5) the transportation plan should be consistent with the ambient air quality standards, with consistency defined as in the joint EPA-FWHA guidelines for implementing Section 109(j) of Title 23, (page 17-18).

ADDITIONAL INFORMATION - FY 77 Regional Operations Guidance, Feb. 18, 1976.

QUESTION - What is emulsified asphalt and is it's use an available control measure?

ANSWER - Emulsified asphalt is asphalt which is in the form of an emulsion using a nonflammable liquid, generally water and/or emulsifying agent such as soap. This type of asphalt does not contain the volatile petroleum distillate used in conventional asphalt paving material. Emulsified asphalt paving is currently being investigated to determine if it represents an available control measure for reducing organic compound emissions.

III-D

AIR QUALITY MONITORING FOR PHOTOCHEMICAL OXIDANT

QUESTION - What is the reference method for determining oxidant in the ambient air?

ANSWER - The Federal reference measurement principle and calibration procedure for determining oxidant in ambient air is the continuous chemiluminescence measurement principle calibrated with neutral buffered potassium iodide (NBKI), as defined in Title 40, Code of Federal Regulations, Part 50, Appendix D. This method is specific for ozone. As previously mentioned, inaccuracies (i.e., positive bias, approximately 5 to 10%) have been noted if the calibration method is not followed carefully. Interim modifications have been sent to the Regions on techniques to minimize such inaccuracies while investigations are continuing on an improved calibration method.

ADDITIONAL INFORMATION - (1) April 14, 1975, Memo from Dr. J.B. Clements, Subj: Clarification of Reference Method for Photochemical Oxidant.
(2) 36 FR 22384, Nov. 25, 1971, As amended at 40 FR 7043, Feb. 18, 1975.

QUESTION - What other measurement methodologies are being used to monitor photochemical oxidant? Are data collected by these other methodologies valid?

ANSWER - In 1973 and 1974 the methodologies in Table I were being used in the field.

TABLE I

Pollutant	Method (Code)	1973		1974		1974		Acceptable	
		No. of Stations	Percent of Total	No. of Stations	Percent of Total	Approved	Unapproved	Unacceptable	
Oxidant 44101	Alkaline KI Instrumental (11)	10	2	6	1			x	
	Coulometric (13)	11	2	5	1		x		
	Neut KI Colorimetric (14)	89	21	77	14		x		
	Coulometric (15)	23	5	33	6		x		
	Phenolphthalin (51)	3	1	0	0		x		
	Alkaline KI Bubbler (81)	79	18	69	12			x	
Ozone 44201	Ferrous Oxidation (82)	91	21	95	11			x	
	Chemiluminescence (FRM) (11)	131	30	277	49		x		
		436	100	562	100				

As can be seen at the present time, data from the Neutral KI Colorimetric (Code 14) and two coulometric methods (i.e., Codes 13 and 15) in addition to the FRM are designated as either approved or unapproved (but acceptable). Unapproved methods may be used until equivalency regulations are promulgated. After promulgation of those regulations (i.e., February 18, 1975), unapproved methods may be used only for limited time periods after which they must be replaced with approved methods. Specifically, this may not be later than 5 years after promulgation for automated methods and six months for manual methods after which time only approved methods are to be used. Use of methods designated "unacceptable" should be discontinued. Further, data collected by such unacceptable monitoring methods should not be used for control strategy purposes. More specifically, data from those methods listed as unacceptable cannot be used for the following reasons:

TOTAL Ox 44101 11 ALKALINE KI-INSTRUMENTAL

The alkaline KI method produces such variable results in different hands that data from one site cannot be compared with data from another.

TOTAL Ox 44101 51 PHENOLPHTHALIN

Results of this method do not agree with those obtained by other total oxidant methods.

TOTAL Ox 44101 81 ALKALINE KI BUBBLER

The alkaline KI method produces such variable results in different hands that data from one site cannot be compared with data from another.

TOTAL Ox 44101 82 FERROUS OXIDATION

Results of this method do not agree with those obtained by other total oxidant methods.

ADDITIONAL INFORMATION - (1) Designation of Unacceptable Analytical Methods of Measurement for Criteria Pollutants, OAQPS 1.2-018, Sept., 1974.

QUESTION - Must a correction factor be applied to relate data from the various "acceptable" methods to the Federal Reference Measurement Principle?

ANSWER - No correction factor need be applied to data collected by any of the "acceptable" methodologies.

QUESTION - Because of the possible inaccuracies associated with the procedure, must past data collected by the acceptable methodologies be adjusted to provide a more accurate level of ambient concentrations?

ANSWER - Insufficient information is available to determine exactly how such data should be adjusted, if at all. The data should be used as is, with recognition given to the possible inaccuracies in a qualitative manner.

ADDITIONAL INFORMATION - December 18, 1975, memo from Roger Strelow to Regional Administrators, Subject: "Errors in Ozone/Oxidant Monitoring System."

QUESTION - Where are maximum ambient concentrations of oxidant observed?

ANSWER - During initial SIP development in 1971-72 and until recently high oxidant levels were believed to be associated with metropolitan areas. However, recent studies have shown that oxidant levels may frequently exceed the NAAQS throughout large areas of the country. It was always realized that oxidant formation is a time-dependent process and that maximum concentrations of oxidant would be observed downwind of the urban center. The studies have shown that oxidant and its precursors may be transported in excess of 100 miles. In some cases the "downwind" concentrations may exceed urban levels. However, such "rural" concentrations are believed to be predominantly caused by transport of oxidant and urban emissions of its precursors. It is now believed that the highest oxidant concentrations will be routinely observed 10 to 30 miles downwind of the metropolitan area; however, the location of instantaneous peak concentrations will vary (i.e., either closer to or farther from the urban area) depending upon meteorological conditions.

ADDITIONAL INFORMATION - Control of Photochemical Oxidants - Technical Basis and Implications of Recent Findings - July, 1975, EPA-450/2-75-005.

QUESTION - How does the ambient NO/NO₂ split influence the design of the oxidant monitoring network?

ANSWER - While this split may have an effect on where highest oxidant concentrations are observed, other variabilities such as meteorology and reactivity of organics emitted will probably have a greater effect.

Oxidant monitors should be located 10 - 30 miles from the urban center in the prevailing wind direction during those periods when peak oxidant concentrations would be expected (i.e., late spring to early fall).

QUESTION - What type of review should be performed to determine whether an adequate number of monitoring sites have been properly located to assure the collection of representative data? When should this review be done?

ANSWER - Air Quality Monitoring Network Design and Instrument Siting, OAQPS 1.2-012, provides guidance on the siting and numbers of monitors that should be operated in the field to give representative information. Further, FY 77 Agency Guidance indicates that especially in those areas with ambient air quality levels above the standard that existing monitoring methods be reviewed this FY to assure that measurements of the maximum photochemical oxidant are being made.

While OAQPS Guideline 1.2-012 recommends that ozone instruments be placed 5 to 15 miles downwind, recent studies have shown that ozone instruments should probably be placed 10 to 30 miles downwind (i.e., prevailing wind direction during daylight hours during oxidant season) of metropolitan areas to measure high concentrations on a routine basis. FY 77 Regional Operation Guidelines states that for oxidant, the Regional Offices should review the general location of oxidant monitors around major urbanized areas to ensure that at least one oxidant monitor is located in areas downwind of principal urban areas. Generally, no

overall increase in the number of fixed station oxidant monitors appears needed at this time. However, whenever possible reorientation of at least one monitor to a downwind location is recommended. Monitors located in rural areas will help provide information on the pervasiveness of the oxidant problem and possibly define the need for additional controls.

ADDITIONAL INFORMATION - (1) Air Quality Monitoring Network Design and Instrument Siting, OAQPS 1.2-012, Jan. 1974; (2) FY 1977

Regional Operations Guidance, February 18, 1976.

III-E

- EMISSION DATA -

QUESTION - What are the major sources of organic emissions in the nation?

ANSWER - The following table is a summary of national organic emissions by major emission category. As may be seen, approximately 50% of organic emissions are transportation related.

NATIONAL ORGANIC EMISSIONS - 1975

Source Type	Percent contribution	Tons/year
<u>Stationary Sources</u>		
Organic solvent evaporation	11.8	3,500,000
Open burning and incineration	10.8	3,200,000
Petroleum storage and transfer	8.8	2,600,000
Chemical manufacturing	6.7	2,000,000
Petroleum refining	4.4	1,300,000
Fuel combustion	4.0	1,200,000
Other industrial sources	2.4	700,000
Total stationary sources	48.9	14,500,000
<u>Transportation sources</u>		
Light duty vehicles	37.0	10,980,000
Heavy duty gas vehicles	7.6	2,260,000
Off highway vehicles	3.7	1,090,000
Heavy duty diesel vehicles	< 0.5	120,000
Rail	< 0.5	110,000
Vessels	< 0.5	100,000
Aircraft	1.9	500,000
Total transportation sources	51.1	15,210,000
Total	100.0	29,710,000

Source: Impact of New Source Performance Standards on 1985 National Emissions from Stationary Sources, EPA Contract 68-02-1382, Task 3, The Research Corporation of New England, Wethersfield, Connecticut.

QUESTION - Must emission inventories of organic compounds contain information on the reactivity characteristics of the emitted organic compound?

ANSWER - Yes and no, depending upon the purposes for which the inventory is to be used. For the purposes of (1) quantifying organic emissions in an area; (2) determining necessary emission reductions to provide for attainment of national standards; or (3) determining the actual reduction in organic emissions that implementation of organic control regulations will achieve, only "total" organic compound emission data not stratified by reactivity are needed. (NOTE: In some cases, however, it may not be possible to determine the composition of the organic compounds emitted. Where it is possible to do so, those emissions attributable to methane may be excluded from the inventory.)

QUESTION - What sources and source information should be in an organic compound emission inventory?

ANSWER - Table 1 is a partial list of major stationary sources that generally emit significant amounts of organic compounds. Each of the point sources within these sources categories should be identified and

included in an organic compound emission inventory. As may be seen, many industries may emit organics from some portion of their process.

In addition to the information that is generally obtained during routine emission data collection activities, the following information should be collected:

(1) Specific organics or class of organics emitted and the amount of such organics emitted - This information may be necessary when determining the applicability of control regulations.

(2) Emission variability - Due to the nature of many organic emissions (evaporative loss), the organic usage and emissions may vary by season, whereas the process may not. Additionally, some sources may have a greater operating rate during the March to October period and therefore have a greater impact on ozone/oxidant levels than a source of the same size which operates at a constant level all year.

(3) Process equipment - In some cases for solvent usage, the operating conditions of the process can be adjusted to reduce emissions. A recommendation to the source to operate equipment at a lower temperature or to place lids on vats of solvents may reduce the solvent usage and thereby decrease emissions of organic compounds.

Mobile sources also account for a large percentage of the organic compounds emitted to the atmosphere and must be inventoried. The inventory should include emission estimates by

(a) Light Duty Vehicles (LDV)

(b) Light Duty Trucks (LDT)

TABLE 1

Major Sources of Volatile Organics From
Industrial Categories

Petroleum Refining, Distribution and Marketing

Miscellaneous point sources - refineries
Vacuum distillation
Process gas combustion
Crude, gasoline, AvGas, distillate, naphtha, etc.

Chemical Manufacture

Ammonia
Carbon black
Charcoal
Paint, varnish and printing ink
Pharmaceuticals
Synthetic resins, fibers and plastics
Organic chemical manufacture

Combustion

Boilers (coal, oil and gas)
Stationary engines

Solvent Evaporation

Degreasing
Drycleaning
Graphic arts
Metal coating

Auto assembly
Can manufacturing
Coil coating
Appliances
Machinery
Commercial products
Furniture

Textile coating and finishing
Paper and film coating
Wood finishing
Tire manufacturing

Other Industrial Sources

Wood processing
Metallurgical processes
Mineral processes
Food processing

- (c) Heavy Duty Gas Vehicles (HDGV)
- (d) Heavy Duty Diesel Vehicles (HDDV)
- (e) Aircraft
- (f) Motorcycles and others

Specific procedures for compiling emission inventories are contained within Guidelines for Compiling a Comprehensive Emission Inventory, APTD 1135. In addition, emission factors and specifications of the type of information needed to calculate emissions from various sources is contained within Compilation of Air Pollution Emission Factors, EPA AP-42.

ADDITIONAL INFORMATION - (1) Guideline for Compiling a Comprehensive Emission Inventory - APTD 1135. (2) Compilation of Air Pollution Emission Factors, EPA, AP-42 with supplements. (3) Source Assessments: Prioritization of Air Pollution from Industrial Surface Coating Operations; EPA 650/2-75-019a, Feb. 1975. (4) Methodology for Inventorying Hydrocarbons, EPA 600/4-76-013, March 1976.

QUESTION - Are emission factors available for natural sources of hydrocarbon?

ANSWER - EPA is currently undertaking studies to expand our knowledge of emission rates for various types of natural sources. It is anticipated that the present study involving vegetation will be complete in early 1977. Some of the natural sources of organic compounds which may be included in the future are biological action, coal fields, natural gas and petroleum fields and natural fires. Until the emission studies are completed, no techniques exist to estimate natural emissions. However, as pointed out on pages III-B-7 to III-B-8, it is believed that the impact of natural sources of organic compounds will not be significant in relation to peak urban levels of photochemical oxidant.

ADDITIONAL INFORMATION - (1) AP-42 - Compilation of Air Pollutant Emission Factors. (2) Air Quality Criteria for Hydrocarbons, AP-64.

QUESTION - What information is required in order to calculate vehicular emissions of organic compounds?

ANSWER - In order to calculate organic compound emissions for mobile sources, it is necessary to know the emission rate by vehicle category (e.g., light-duty vehicles, light-duty trucks, heavy-duty vehicles, etc., and vehicle year) and to know the number of miles travelled by each vehicle category by vehicle year.

With respect to vehicle emission rates, EPA has determined emission rates by vehicle category and by vehicle year. The results are published in Compilation of Air Pollutant Emission Factors, AP-42. Emissions vary by model year because of (a) emission control devices, (b) deterioration of such devices, and (c) varying engine characteristics. Also because emission control systems deteriorate with time, the emission factor for a 1974 car will be different in 1975 than in 1974. Therefore, to accurately calculate mobile source emissions, it is necessary to know the number of miles traveled by each model year of vehicle in the specific calendar year for which emissions are to be determined.

Information on vehicle usage within a given area can be usually obtained from local or State planning agencies, or agencies dealing with motor vehicles. To the extent possible, the following information should be obtained from such agencies for the study area in question.

(a) VMT by vehicle category

(b) Age distribution of vehicles by vehicle category

(c) Anticipated growth in VMT by vehicle category

If such data are not available, use of national averages which are contained with AP-42 can be used.

The specific procedure for calculating emissions may be found in AP-42.

ADDITIONAL INFORMATION - Air Pollutant Emission Factors, EPA AP-42, Third Printing, February 1976. (A new supplement will be available shortly), Strelow, R., to Regional Administrators, memorandum, "Guidance for Determining Acceptability of SIP Regulations in Non-Attainment Areas," December 9, 1976.

III-F

- CHEMISTRY OF PHOTOCHEMICAL OXIDANT -

QUESTION - What is the difference between oxidant and ozone?

ANSWER - Oxidant is not a specific compound but is a broad group of diverse compounds with the predominant constituent, ozone (O_3), as an indicator of their presence. Oxidant is generally not emitted directly from sources but is formed in the atmosphere as a product of various reactions of its precursors (i.e., organics and oxides of nitrogen). As presently used by the Agency, the term applies to those compounds produced by the interaction of NO_2 , organics and oxygen in the presence of ultraviolet radiation. Two basic components of photochemical oxidant are (1) ozone - O_3 and (2) peroxyacetyl-nitrate - (PAN) - $CH_3 CONO_2$. Laboratory studies have shown that aldehydes such as (1) formaldehyde - H_2CO , (2) acetaldehyde - CH_3HCO , and (3) other organic compounds may also be formed along with oxidant.

Attempts have been made to quantify the relationship between total oxidant and ozone. This has generally been done through the use of dual monitors at the same location, one specifically for ozone and the other which measures all constituents of photochemical oxidant (generally through the use of potassium iodide (KI)). These measurements theoretically should provide the concentration of oxidation products other than ozone. Some of these attempts to determine the percent of ozone in total oxidant has resulted in the measurement of ozone concentrations greater than total oxidant concentrations. This in part has resulted from the difficulty in making an accurate measurement of total oxidant and negative

interferences of other substances; there may also be other, unknown reasons. Most of this work has been done in Los Angeles, California, and it was found that the percent of ozone to total oxidant varies with meteorology and season; however, no explanation for this variation has been found. It was generally found that ozone constitutes approximately 90% of total oxidant, although ozone fractions as low as 75% have been found. It is conceivable that the ozone fraction will also vary by concentration level and types of hydrocarbons emitted.

ADDITIONAL INFORMATION - Control of Photochemical Oxidants - Technical Basis and Implications of Recent Findings, July 15, 1975, EPA 450/2-75-005.

QUESTION - When and how rapidly is O_3 formed?

ANSWER - Due to the dependence upon sunlight, the photochemical formation of ozone does not begin until sunrise. Due to the fast reaction with NO , ozone buildup does not occur until almost all NO is depleted. Peak concentrations of ozone are usually reached approximately 2 to 3 hours after the NO_2 has reached its peak. High concentrations of ozone persist until the afternoon when reduced ultraviolet radiation decreases the reaction rate of the photochemical cycle and increases in automotive traffic increase the urban concentration of NO . High ozone concentrations have been observed at night and this is generally ascribed to transport of ozone aloft from one area to another. Atmospheric stratification (ground

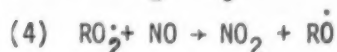
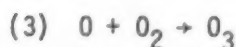
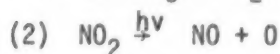
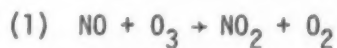
level inversions) which frequently occurs at night may effectively shield ozone from newly emitted NO. The ozone thus trapped will not be depleted due to the scarcity of those compounds which normally reduce ozone. As the air parcel with the trapped ozone passes over the urban area the inversion may be broken by the topography of the urban area or by the fact that the ground level air is generally warmer than the upper level air, producing vertical mixing. An earlier rise in oxidant levels may also occur as the ground level inversion is destroyed by solar heating, allowing ozone aloft to become mixed with ground level emissions resulting in an earlier rise in ozone levels.

ADDITIONAL INFORMATION - (1) Control of Photochemical Oxidants - Technical Basis and Implications of Recent Findings.

QUESTION - How is oxidant formed/depleted?

ANSWER - There are presently over 300 reaction steps postulated in the formation of photochemical oxidant. There are, however, a few basic steps which generally describe the formation mechanism (Figure 1). The constituents of oxidant are secondary pollutants that form in the atmosphere. Elements which must be present for oxidant formation are NO, organics, oxygen, and ultra-violet light (sunlight). Although

oxidant may be present at almost any time of the year, oxidant in excess of the standard is generally found during spring and through late summer. Simplistically, nitric oxide (NO) reacts with either ozone (O_3) or oxygenated organic radicals (RO) to form nitrogen dioxide (NO_2) (Reactions 1 and 4). The NO_2 then photodissociates (Reaction 2) with the free oxygen combining with oxygen molecules (O_2) to form O_3 (Reaction 3). See Figure 2 for a schematic of the formation cycle.



As already shown (Reaction 1), ozone may also be depleted. Some of the depletion steps (Reactions 5 and 6) may result in compounds which generally do not participate further in the photochemical cycle.

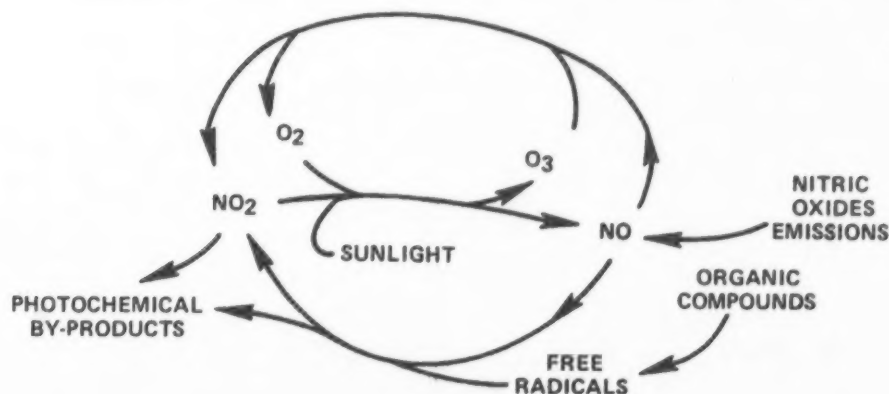
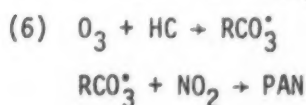
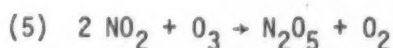


Figure 2

Photochemical production of oxidants.

ADDITIONAL INFORMATION - Control of Photochemical Oxidants - Technical Basis and Implications of Recent Findings.

QUESTION - What is the interrelationship between organics and NO_x in oxidant formation?

ANSWER - Organics and NO_x are the two major constituents in oxidant formation. The exact relationship and effects that increase or decrease ambient levels of either pollutant is currently under investigation within the Agency. However, it is known that NO emissions may depress ozone around an NO source (i.e., excess NO to available organics would tend to deplete O_3), increased levels of ozone may be observed downwind from an NO source, because the subsequent conversion of NO to NO_2 provides a needed precursor to initiate the reaction necessary to produce oxidant.

Notwithstanding the above, evaluation of smog chamber studies indicates that for most broad metropolitan areas control of NO_x emissions to minimize ambient oxidant levels would be much less effective than the control of organic compounds. It is believed that the ratio of ambient non-methane organics (NMOC) to NO_x (i.e., NMOC/ NO_x ratio) in urban areas is such that reduction in ambient concentrations of Ox are best achieved by control of organic compound emission sources rather than NO_x sources. The relationship is complex and preliminary, and further work on the subject is continuing.

ADDITIONAL INFORMATION - (1) Control of Photochemical Oxidants - Technical Basis and Implications of Recent Findings; (2) Oxidant Control Strategies, Part I. An Urban Oxidant Control Strategy Derived from Existing Smog Chamber Data. Dr. B. Dimitriades, 1976 - Submitted for publication. (3) Combined Use of Modeling Techniques and Smog Chamber Data to Derive Ozone-Precursor Relationships, Dr. M.C. Dodge; (4) An Alternative to the Appendix J-Method for Calculating Oxidant - and NO₂ - Related Control Requirements, Dr. B. Dimitriades. NOTE: References (3) and (4) were presented at the International Conference on Photochemical Oxidant Pollution and its Control, Raleigh, N.C., 1976.

QUESTION - What are the Meteorological Factors Affecting Oxidant Levels?

ANSWER - Recent studies have revealed various meteorological factors conducive to the occurrence of high oxidant concentrations. These include moderate to strong solar ultraviolet radiation, maximum daily temperatures generally above 60° F, low surface winds (≤ 8 mph), lack of a surface-based radiational inversion but vertical mixing limited by a subsidence inversion aloft, and existence of a slow moving high pressure air mass system with highest concentrations developing toward the center and back sections of such a system. High oxidant concentrations are a complex function of precursor emissions initially generated in an area or region and some combination of the above meteorological conditions.

Recent evidence suggests that relatively high concentrations may occur simultaneously over rather large geographic regions. However, the highest levels are observed in the vicinity of urban areas usually 15 to 30 kilometers downwind of the central business district. Therefore,

relative to an urban area the prevailing wind direction is also of importance. The incremental contribution to oxidant concentrations of precursor emissions in individual urban area will depend on factors such as urban area size, emission densities, the resulting atmospheric pollutant mix, and proximity to upstream urban areas with sizable precursor emissions.

ADDITIONAL INFORMATION - Formation and Transport of Oxidants Along Gulf Coast and in Northern U.S., EPA 450/3-76-033, August 1976.

SECTION IV

Inspection/Maintenance Operation Experience

iv-i

JAN 1977

Location: Cincinnati and Hamilton County, Ohio

Type of Program: Municipally operated permanent facilities, idle mode, mandatory inspection and maintenance.

Sites: Cincinnati - 1 site, 4 lanes, includes safety inspection
Norwood - 1 site, 1 lane, includes safety inspection
Hamilton County - 2 sites (Newtown and Glenway), 3 lanes total, no safety inspection.

Chronology: Fully mandatory I/M began in Cincinnati and Norwood on Jan. 1, 1975, with no voluntary phase-in periods. Newtown began operation 8/75 and Glenway 9/75. Operations ceased at Newtown and Glenway, Feb. 1, 1976.

Geographic Coverage: Eventually the whole of Hamilton County, about 600,000 LDV's.

Administering Agency: Individual local governments

Capital Cost: (Cincinnati) \$12,600 for 9 analyzers -- inspection facilities already in operation for safety.

Operating Cost: (Cincinnati) \$130,000 for 11 additional positions.

Cost to Motorist: \$3.75, including safety.

Standards: Same as Chicago, four-stage standards dependent on model year -- projected 30 percent rejection.

Enforcement: (Cincinnati) Vehicle cannot be registered by City (sticker issued) unless inspection is passed. City Division of Air Pollution Control has four vehicles issuing tickets on a limited basis.

(Hamilton County) No enforcement program.

Instrumentation: Sun # 910 I analyzers modified with color-coded scales and pass/fail lights. Cincinnati has 9 of these, Norwood 2, and Hamilton County 4.

Data Collection: Volumes passing and failing only. By November '75, Cincinnati vehicles were failing at 17 percent and Norwood at 28 percent, both down considerably from program inception.

Mechanic Training: None at present, but need exists. Region V is planning courses and CSU has been contacted. City has responded favorably to letter by Region concerning program.

Waiting Times: No major problems

Achievements: Demonstrated short lead time adding I/M to existing safety program.

IV-2

JAN 1977

Location: Chicago

Type of Program: City-operated mobile vans, idle mode. Mandatory inspection with no enforcement = voluntary inspection. Voluntary maintenance.

Sites: 9 sites, 18 lanes

Chronology: Began inspection in June 1973. EPA Region V issued enforcement (s 113) order to City to meet inspection rate of 3000 vehicles/day by December 1975. If failing to comply, mandatory inspection and maintenance of all Chicago and Cook County vehicles entering Loop was to commence March 1976.

Geographic Coverage: City of Chicago only (1.0 million LDV's), but any vehicle coming in will be inspected. Remainder of Cook County is far behind in implementation.

Administering Agency: City of Chicago, Department of Environmental Control

Capital Cost:

Operating Cost: \$1.65 million per year (estimated)

Cost to Motorist: Inspection fee collected as part of annual registration fee, which was raised \$5 at the time of I/M inception. Cost of testing is about \$2.25 per vehicle.

Standards: CO and HC standards for four model-year groups - estimated 30 percent rejection.

Enforcement: None

Instrumentation: 18 Sun # 910 I analyzers, modified to include CO2 testing and computer control. 11 backups w/o CO2 modification.

Data Collection: Record kept on rejected vehicles, esp. model year 1975's, which are failing at above 20 percent. Study done in conjunction with EPA's Emission Factor Program showed 75's failing at 28 percent (on Chicago test).

Mechanic Training: Definite need, but none to date.

Waiting Times: No problems

Location: Portland, Oregon

Type of Program: Combination of permanent and mobile facilities, idle mode, mandatory inspection and maintenance. Inspection is biennial at present.

Sites: 5 permanent sites, 10 lanes; 4 mobile vans, 5 lanes
9 sites, 15 lanes total. Plans call for expansion to 17 lanes.

Chronology: Voluntary inspection and maintenance commenced 1/74. In 18 months, 105,000 vehicles were tested. No transitional mandatory/voluntary phase. Fully mandatory I/M began 7/1/75.

Geographic Coverage: Portland Metropolitan Service District -- urbanized portions of Washington, Multnomah, and Clackamas Counties (580,000 LDV's total).

Administering Agency: Oregon Department of Environmental Quality (DEQ)

Capital Costs: Total cost of analyzers (29) was about \$200,000. Only one station was actually built for the program, construction costing \$77,000. Located on State right-of-way, land costs are not included. This station has loaded-mode and safety testing capabilities. The four remaining permanent facilities are leased. A complete mobile van setup, including new vehicle, 3 analyzers, and secondary equipment, costs \$40,000.

Operating Cost: Approx. \$1.6 million for "on" year, \$1.0 million for "off" year.

Cost to Motorist: \$5 for issuance of Certificate of Compliance. Unlimited retests.

Standards/Failure Rate: Multiple standards, based on manufacturer's specs, involving model year groups, manufacturer groups, and engine modifications. Testing involves pre-conditioning to offset hot idle effect. Vehicles can also be rejected for exhaust dilution, visible smoke, and excessive idle speed. Total failure rate is about 35 percent.

Enforcement: Vehicles cannot be registered without Certificate of Compliance

Instrumentation: 29 Sun "OEA 75" analyzers with digital readout of HC, CO, and CO₂, and with remote viewing gauges. Systems are fully computer compatible, but are not computer controlled at this time. For supplementary data generation, 2 Clayton and 2 Autoscan dynamometers are used. Oregon State University has CVS testing capabilities.

Data Collection: Actual rejection rate, Dec. '75, was 32%. Refailure rate of 16%. Record kept of all emission readings. Readings are taken at idle speed, 2500 rpm (intended mainly as pre-conditioning), and then again at idle, with the lower of the idle readings governing. Supplementary loaded testing is also performed occasionally, with testing at 30 and 50 mph under loads proportional to vehicle weight.

Mechanic Training: Emission-related tune-up course at Clackamas Community College, in response to Oregon I/M. EPA Region X Assisted with funding through DEQ. 75-80 enrollees.

Waiting Times: With 1976 as an "on" year, a "reasonable maximum" (at the Powell St. Station) is one hour. To combat long waits, DEQ keeps inspection lanes open on seven-day basis and licenses private fleets (more than 100 vehicles) to inspect themselves. During the "off" year of 1975, no waiting problems existed.
Total inspection time averages 3 minutes.

Achievements: Downward trends in ambient CO have been noted, but contribution of I/M is not known.
Many garages are buying analyzers.
Of all I/M programs, has the most extensive, and therefore the most equitable standards. Difficulties in identifying vehicles and their standards have been minimal.

Location: Riverside

Type of Program: State-operated permanent facilities, loaded mode (hi-cruise, lo-cruise, idle). Mandatory inspection with voluntary maintenance at present.

Sites: 2 sites, 6 lanes. Second station opened Feb. 19, 1976.

Chronology: Phase I (pilot program) - began inspections 9-2-75. Assuming success of Phase I, Phase II begins 9-76 and Phase III late in 1977. Under Phase II, program expands to 25 sites with fully mandatory I/M for those vehicles requiring registration changes (approx. 1.7 million vehicles). Phase III, with 80 to 85 stations of 2 and 4 lanes (290 total), requires fully mandatory I/M for all registered vehicles on a yearly basis.

Geographic Coverage: Presently, City of Riverside only (120,000 LDV's). Phases II and III will expand program to the remainder of the South Coast Air Basin (approx. 6.6 million vehicles), including the whole or parts of Riverside, San Bernardino, Los Angeles, Orange, Ventura, and Santa Barbara Counties.

Administering Agency: California Bureau of Automotive Repair - administration. California Air Resources Board - operations.

Capital Cost: \$250,000 for 6 lanes of equipment (analyzers, dynos, computer control). Land and building of currently operating station are leased on a monthly basis.

Cost to Motorist: Free at present. Phases II and III, \$5.00 (estimated). Waiver System - Maximum mandatory repair cost is \$150 or 20 percent of the vehicle's value, whichever is smaller. This limit is provided to the vehicle owner via the computer printout he receives.

Standards/Failure Rate: Matrix of standards for three model year groups, two engine size groups, and the presence or absence of air injection. Projected rejection under these standards is 25 percent. Standards will be updated as required. Vehicles may also be rejected for obvious safety deficiencies (bald tires, etc.) that may cause testing to be unsafe. Vehicles 1955 and older are exempt from program.

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Enforcement: Phase I - not applicable.

Phase II - changes in registration (buying, moving into State, etc.) cannot be made without passing inspection.

Phase III - annual renewal of registration and changes in registration cannot be made without passing inspection.

Instrumentation: For Phase I, most analysis equipment, including dynamometers, was manufactured by Autoscan. System uses computer data processing.

Data Collection: Odometer readings and vehicle age along with tailpipe concentrations of CO, HC, and NOx. Computer hookup (to tailpipe and engine) permits instant diagnosis, with three-mode analysis of emission readings. Vehicle owner is provided with printout, indicating probable cause of malfunction and recommended service action. After one month's operation, vehicles were being rejected at about 30 percent.

Accompanying Phase I is a surveillance program involving 650 vehicles. Anticipated results of this effort include program effectiveness (utilizing the 1975 FTP), cost effectiveness, and "technical effectiveness" (vehicle thruput, waiting times, etc.). Final report should be available by mid-March 1976.

Mechanic Training: California has a program of mechanic licensing.

Under Phase I, a "certificate of qualification" is required of mechanics to perform repairs resulting from the I/M program. These mechanics must attend an orientation seminar and either:

- (a) possess a California "Class A" mechanic's license
- (b) pass a written examination

Waiting Time: No problems. Demand is kept uniform by mailing out notices to 450 to 500 vehicle owners daily (chosen at random by computer). The owner then has two weeks from date of postmark to bring in his vehicle. Total inspection time is about seven minutes.

Achievements: Public reaction has been excellent. Unique combination of exhaust analysis, engine monitoring, and computer technology. Diagnosis helps insure satisfied consumer.

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